MODERN Machine Shop

A Magazine for Machine Shop Executives
HOWARD CAMPBELL, Editor

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CONTENTS

	Page
CHARACTERISTICS OF ALLOY STEELS, I. *By George M. Enos*	9
HOT-INDENTING WITH A COMBINATION PUNCH PRESS AND ELECTRIC WELDER. *By Avery E. Granville*	20
FACTORS THAT INFLUENCE MILLING COSTS. *By R. H. Kasper*	26
LIABILITY OF MACHINE SHOP OWNER FOR CONTRACTS MADE BY EMPLOYES. *By Leo T. Parker*	34
IDEAS FROM READERS	38
—A "HOME-MADE" OVERHEAD SHAFT OILER, *By Morris A. Hall.*	
—AN EFFICIENT DRILLING AND TAPPING JIG, *By Avery E. Granville.*	
—PLUG GAGE FOR SELECTIVE ASSEMBLY, *By Ernest Foldvary.*	
—GUIDE FOR THE CUTTING TORCH, *By R. H. Kasper.*	
—CENTERLESS GRINDING CYLINDRICAL PARTS WITH IRREGULAR-SHAPED ENDS, *By V. C. Huntington.*	
—USES OF THE BORING DISC, *By Adrian F. Mougey.*	
"OVER THE EDITOR'S DESK"	50
NEW SHOP EQUIPMENT	52
FOR YOUR CATALOG LIBRARY	74
"THE SCRAP PILE"	80
INDEX TO ADVERTISEMENTS	82

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MODERN Machine Shop

DECEMBER, 1931

CINCINNATI, OHIO VOL. 4, No. 7

Characteristics of Alloy Steels, I

The first of three articles dealing with the characteristics, uses and treatment of alloy steels as used in the making of tools and dies.

By GEORGE M. ENOS,
Assistant Professor of Metallurgy, University of Cincinnati

MEN who are concerned either directly or indirectly with the uses and heat treatment of alloy steels should know (1) where to find information concerning the steels in use or being considered for use, (2) what kind of information to look for, and (3) how to interpret the information when it is obtained. It is the purpose of this article to discuss briefly the characteristics of alloy steels from the viewpoints just mentioned.

Where to Find Information Regarding Alloy Steels

The most reliable source of information regarding steel should be the manufacturer of the steel. It is to the advantage of the company's agent to tell the truth regarding his product. Naturally, however, the information obtained from the manufacturer should be checked by reference to unprejudiced sources, and the steel should be compared with steels made by other companies. Many sources of reliable information are available, including the publications of the various engineering societies, the text books of Bullens and Sauveur, and others.

One of the difficulties in making comparisons of alloy steels is that they are generally sold under trade names, and the analyses must first be ascertained before comparisons can be made. Nor can comparisons be made on the basis of analysis alone, for certain physical and mechanical properties of the steel must also be considered.

What Kind of Information Should Be Sought?

First, the potential user should learn the purposes for which a particular alloy steel is recommended by the manufacturer and by unprejudiced authorities. Then the nominal analysis of the steel should be ascertained, together with the heat treatment necessary to develop the desired properties. Finally, all the inherent characteristics of the steel which may be of possible advantage or disadvantage in processing should be noted.

The Interpretation of Information

No amount of data regarding steels is of any advantage unless it can be organized and interpreted. The interpretation requires some experience or

training. Often it will be found that two or more steels seem suitable for the same general purpose because of similarity of analysis or physical and mechanical properties. The question then becomes one of economics, to be decided upon the basis of (1) the availability of the steels in the sizes and shapes desired, (2) ease and simplicity of heat treatment, (3) possession of an added advantage such as suitability for other uses, resistance to corrosion, and so on, and finally, (4) cost.

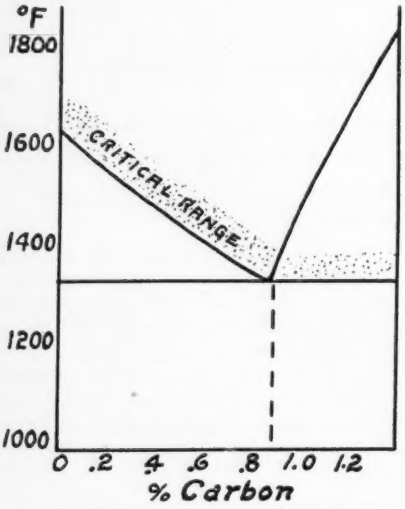

Fig. 1—Portion of the iron-carbon diagram which is of special interest to heat treaters.

Alloy steels are used for the making of tools and dies because, in general, greater strength values can be obtained from an alloy steel of the proper composition than from a plain carbon steel. For best results, both plain carbon steels and alloy steels must be heat-treated. Under certain conditions an untreated alloy steel might approximate strength values obtainable in a plain carbon steel that has been properly heat treated, but it is obvious that the full value of the alloy steel, as represented by a higher cost, should be obtained by using it in the heat treated condition.

In addition to strength values, alloy steels have other advantages which may be summarized as follows:

1. Many types of alloy steels can be hardened to a greater degree than plain carbon steel, or hardened to the same degree with less danger of cracking, warping, or distortion.
2. The "fatigue resistance" of certain alloy steels is greater than that of plain carbon steels, and hence they can be used where alternating or repeated stresses are encountered. By "fatigue resistance" is meant the ability of the steel to stand up under the hard service that tends to produce failures which are often, although erroneously, called "crystallization" failures.
3. The dynamic properties of certain alloy steels are superior to those of plain carbon steels, and thus alloy steels can be used to better advantage where shock is to be encountered.
4. Some alloy steels resist high temperatures better than plain carbon steels, and do not deteriorate nearly as much when subjected to high temperatures in service.
5. Alloy steels of certain types are more resistant to corrosion than plain carbon steels. This is especially true of those containing high percentages of chromium.

Heat Treatment of Steel

It is beyond the scope of this article to discuss in detail the usual processes of heat treating. It is well to remember, however, that the theory and practice of heat treating plain carbon steels is based on the iron-

carbon equilibrium diagram. That portion of the diagram which is applicable to the annealing and hardening of steel is shown in Fig. 1. This diagram illustrates how the "critical range of temperature" varies with the carbon content of the steel.

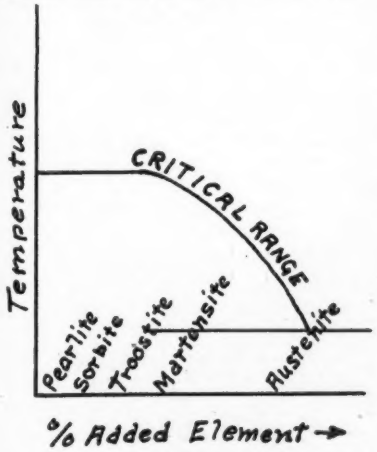

Fig. 2—Diagram showing how increasing the percentage of an alloying element decreases the critical range on cooling, carbon percentage fixed. The microconstituents which would probably be present on slow cooling are also indicated.

It is comparatively easy to study and plot changes occurring in an alloy such as plain carbon steel when only two elements are present, because variations in temperature and composition can be plotted on a plane. Although ordinary carbon steels contain small amounts of manganese, silicon, sulphur, and phosphorus, the effect of such small percentages of these elements on the critical range is negligible. With alloy steels, the graphical representation of the effects of varying composition and temperature is more difficult.

An alloy steel is a steel which owes its distinctive properties to some element or elements other than the carbon or the small amounts of other elements usually present in steel. If only one other element is added, there are three ways in which the effects of the element on the critical ranges might be shown. One way is to fix the percentage of carbon, and show how the change in percentages of added element changes the location of the critical range. Another way is to fix the percentage of the added element and plot the change of critical range with change in carbon content. The third way is to plot the percentages of added element against percentages of carbon and note how the microconstituents of the steel are changed on slow cooling. These methods are indicated in Fig. 2, 3, and 4.

If more than one alloying element is added, as is often the case, the graphical methods are almost useless and the proper heat treatment must be determined experimentally for each and every analysis. Then tabulated data, rather than a diagram, should be used by the heat treater.

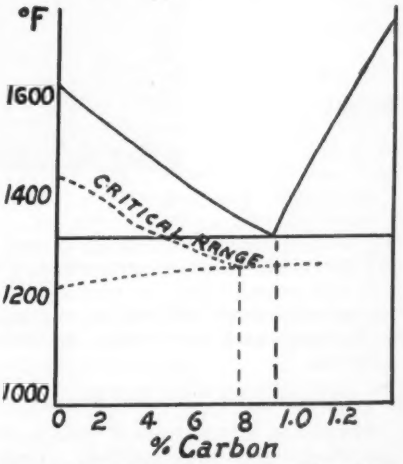

Fig. 3—Diagram indicating the lowering of the critical range, for various carbon percentages, when the percentage of added element is fixed.

In the discussion which follows, the effects of added elements will be

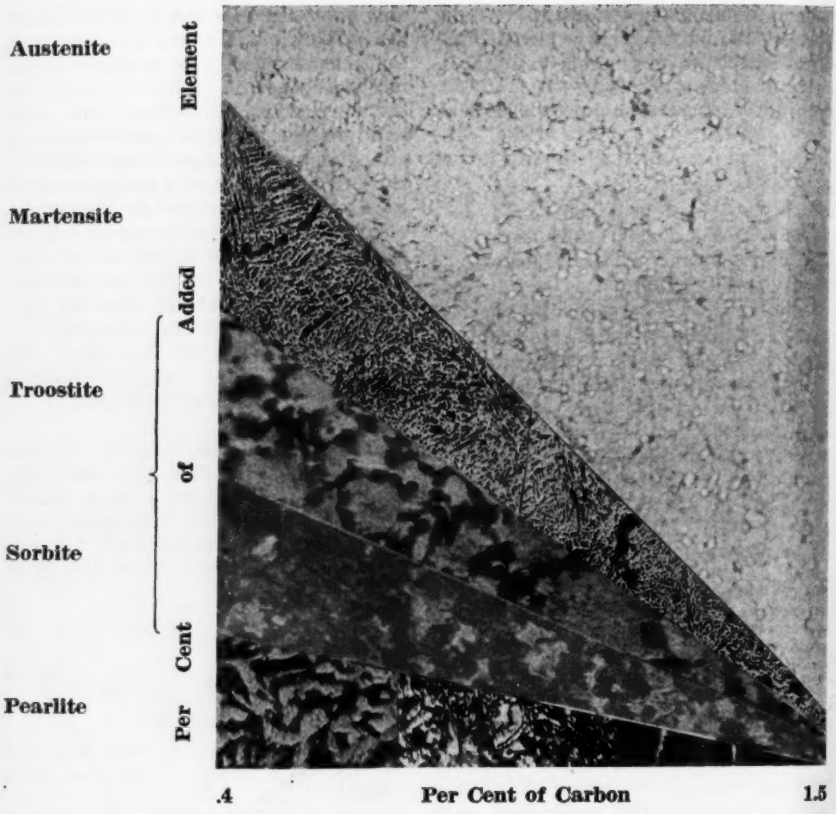

Fig. 4—Composite photomicrograph showing relationship between per cent of carbon and per cent of alloying element, as expressed in terms of the microconstituents which will be present on slow cooling.

stated empirically without attempting to illustrate each case with a suitable diagram.

Classification of Alloy Steels

There are many ways in which alloy steels may be classified. Only three of the more important methods, however, will be discussed. The first is the Society of Automotive Engineers Classification (S. A. E. System), in which each steel listed is designated by a number of four or more digits. The first digit designates the type of steel, the second indicates the approximate percentage of the principal alloying elements, and the next two numbers indicate the points of carbon. (1 point of carbon = .01%C). The types designated by numbers are: 1, plain carbon steels; 2, nickel steels; 3, nickel chromium steels; 4, molybdenum steels; 5, chromium steels; 6, chrome-vanadium steels; 7, tungsten steels; 9, silico-manganese steels.

Examples: S. A. E. 1020 designates a plain carbon steel with .2 per cent carbon. S. A. E. 3145 specifies a

nickel chromium steel with about 1 per cent of nickel and .45 per cent of carbon. It should be noted that the complete specifications given for the various steels designated by these numbers limit the phosphorus and sulphur, and state the range of the manganese content. The carbon range is usually 10 points. Thus S. A. E. 1020 would designate any plain carbon steel containing between .15 per cent and .25 per cent carbon, whose limits on phosphorus, sulphur and manganese were within those stated in the specifications of the Society of Automotive Engineers. Actually, many steels not specified by the Society can conveniently be classified under this system. The system is really a short-hand method of indicating specifications for chemical analysis.

In the second method, the steel is classified according to use. Alloy steels may be classified in this manner. Steels of various analyses may be used for the same purpose, or general type of service. Thus "magnet" steel, "die" steel, "tool" steel, "spring" steel, and so on, are terms often used.

The heat treating characteristics of the alloy steels may also form a basis for a third method of classification. Thus we have "air-hardening" steels, "oil-hardening" steels, and "water-hardening" steels, and these terms may be coupled with some other characteristic. A certain steel might be described as an "oil-hardening, non-shrinking tool steel." If this description be accompanied by the chemical analysis, either as the type analysis or the S. A. E. number, a fairly accurate abstract of the characteristics of the steel may be obtained.

The Alloying Elements

Naturally, the list of elements which might be used in alloy steels is rather long. There is a reason for the use of each element, however, and they may be summarized as follows:

1. Certain alloying elements are added in the process of the manufacture of the steel to neutralize the effects of other elements; thus, Titanium is occasionally used to reduce the oxygen and nitrogen content. Silicon and manganese are used as deoxidizers, and manganese also unites with sulphur, as does zirconium. Manganese and zirconium tend to overcome the bad effects of sulphur. Aluminum and vanadium are used to deoxidize and degasify.

2. Vanadium and aluminum are two elements that are frequently used in small quantities, but in excess of the amounts needed for the purpose stated above, because of beneficial effects which are thus far but little understood.

3. Certain alloying elements unite with and strengthen the ferrite (iron constituent of steel as distinct from the iron carbide). These elements are nickel, chromium, manganese, and tungsten. The last two elements divide themselves between the iron and the iron carbide.

4. Certain alloying elements unite with the carbon and iron of the iron-carbon compound, forming complex carbides which harden the steel. These include manganese, chromium, tungsten, molybdenum, and vanadium.

5. Alloying elements may raise or lower the critical points of the steel. Nickel and manganese lower the critical ranges on both heating and cooling. Chromium, tungsten, molybdenum, and silicon raise the critical ranges on heating.

6. Other alloying elements are used for special purposes not included in the other classifications, such as chromium in corrosion-resisting steels, nickel in Invar (a material which has a negligible coefficient of expansion), and so on.

It will be noticed that some of the elements are useful in the steel for several different reasons. Further

TABLE I.

Ranges of Compositions of Some Alloy Steels Suitable for Dies and Tools. Phosphorus and Sulphur Content Assumed Below Harmful Percentages.

Types of Alloy Steels	Per cent Carbon	Per cent Manganese	Per cent Chromium	Per cent Vanadium	Per cent Molybdenum	Per cent Tungsten	Per cent Nickel	Per cent Silicon
Carbon Tool Steels, small additions of chromium or vanadium, or both (Water-hardening).	.7 to 1.3	.25	.50	.2	....	....	not over .15	.025
High carbon, low tungsten tool steels. (Oil and Water Hardening).	1.0 to 1.25	*	.50	.2	....	1.0 to 2.7	....	*
High carbon, high chromium, Tool Steels, Dies. (Oil Hardening).	2.25 to 2.0	.25 to .15	11.00 to 12.00	.... to .80	....	....	....	.25 to .30
Low carbon, low alloy Tool Steels (Oil Hardening).	.40 to .60	*	.75 to 1.65	.25	....	....		*
Hot Working Die Steels. (Oil or Air Hardening).	.25 to .45	.20	1.5 to 7.0	.25 to .50		7.0 to 15.		.20 to .30
Chromium Bearing Die Steels. (Oil Hardening).	.85 to .95	*	3.25 to 4.0	....	....	....	....	*
Manganese. Oil Hardening).	.85 to .90	1.0 to 1.5	....	....	....	....	....	*
High Speed Steels. (Air or Oil Hardening).	.55 to .80	*	3.25 to 4.25	.7 to 2.10		13.0 to 21.	....	....

* Present, but percentage not important as long as within conventional ranges.

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THE manufacturers of this profitable tool room machine realized, of course, that the fundamental feature of the equipment is its flexible shaft. This one element in particular in the design of the machine, *must be right.* Is it any wonder that S. S. White Flexible Shafts are used exclusively in all "Kellerflex" machines?

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The "Kellerflex" is a handy and time-saving tool room machine, built by the Keller Mechanical Engineering Corporation, Brooklyn, N. Y. It is strictly a quality machine, fully capable of meeting the extreme demands of die-making, pattern work, etc. The Kellerflex is built in several sizes and types. Essential to the success of these machines is the dependable, true-running S. S. WHITE Flexible Shafts which carry their power to the work.

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mention might be made of the elements in Group 5. Although chromium, vanadium, molybdenum, tungsten, and silicon raise the critical range on heating, and a higher temperature for the heat treating is necessary, a slower rate of cooling may suffice to produce a hardened structure than would be the case in plain carbon steel.

While alloying elements other than those mentioned above are sometimes used, as, for example, cobalt in high speed steels, the elements mentioned are the most important. The variations in ranges of composition of a number of alloy steels often used in tools and dies are given in Table I.

(The second article of this series will be published in the January, 1932, issue.)

Monarch-Keller Form-Turning Machine Catalog

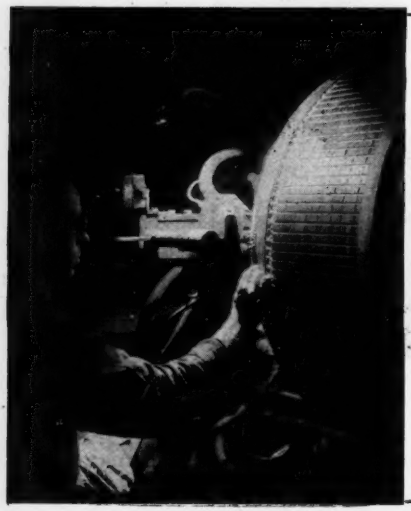
The Monarch-Keller Form-Turning Machine is featured in a 28-page catalog that has been issued by The Monarch Machine Tool Co., Sidney, Ohio. The machine is a combination of the Monarch Helical Geared Timkenized Lathe and the Keller automatic electric controls that have made the Keller Automatic Engraving Machine the outstanding machine of its type. The electric controls are built into the lathe, forming a complete unit.

The Monarch-Keller Form-Turning Machine is primarily designed for machining any irregular contour—triangular, square, hexagon, or other shape—in addition to round or oval, for which a thin master template can be made. The machine finds its widest application in the machining of punches, dies, molds, mill rolls, and similar work which, prior to the development of this machine, has been slow, laborious, and expensive.

The text and illustrations make clear the reasons why the Monarch-Keller machine is extremely simple of operation, yet marvelously accurate. Parts are turned, faced, and bored automatically, the cutting tool following the course dictated by a tracer which is governed by automatic electric controls and the finished job is invariably accurate to within 0.001 in. of the master template.

A copy of the catalog can be had upon request.

The most progressive manufacturer can give you the best service. The manufacturers represented in these pages are leaders in their industry; patronize them and mention MODERN MACHINE SHOP when doing so.



Electric Brazing Machine Brazes Motor Connections

After the rotor for an electric railway motor has been wound, this electric brazing machine makes the connections tight and positive. This machine and two others of the same type are now in operation in the East Pittsburgh Works of the Westinghouse Electric and Manufacturing Company. They form a part of the equipment that is engaged in the production of the electric motors for 90 new electric locomotives for the Pennsylvania Railroad.

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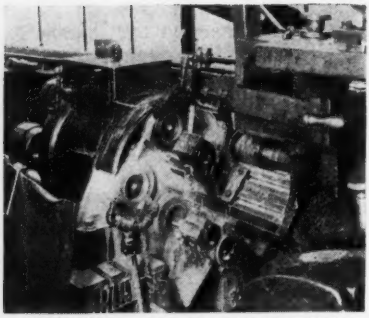
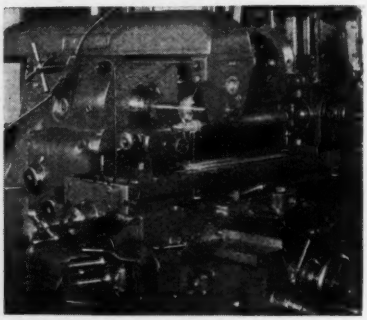


Courtesy of National Acme Company, Cleveland, Ohio

OPERATION: FACE BORE. CHAMFER AND TAP
MACHINE: GRIDLEY 4 SPINDLE 1¼ IN. CHUCKING MACHINE.
MATERIAL: STEEL STAMPING.
FACE: 245 FEET PER MINUTE.
BORE: 226 FEET PER MINUTE.
CHAMFER: 100 FEET PER MINUTE.
TAP: 46 FEET PER MINUTE.
LUBRICANT: 1 PART SUNOCO TO 10 PARTS WATER.



Courtesy of Cincinnati Milling Machine Company, Cincinnati, Ohio

OPERATION: MILLING KEYWAY ON SHAFT.
MACHINE: NO. 2 CINCINNATI MILLING MACHINE.
MATERIAL: STEEL FORGING.
CUTTER: 4 IN. 51 R. P. M.
FEED: 3½ IN. PER MINUTE.
WIDTH OF CUT: ⅝ IN.
DEPTH OF CUT: 3/16 IN.
LUBRICANT: 1 PART SUNOCO TO 20 PARTS WATER.

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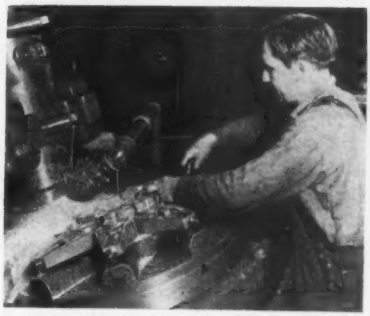
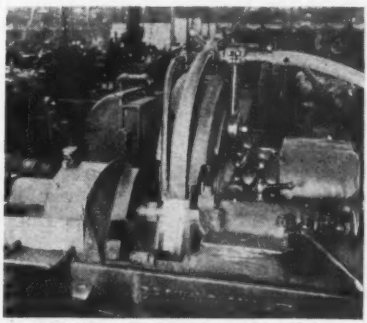


Courtesy of Oesterlein Machine Company, Cincinnati, Ohio

OPERATION: MILLING BEARING PLATES.
MACHINE: OESTERLEIN 40 IN. TILTED ROTARY MILLING MACHINE.
MATERIAL: MALLEABLE IRON.
CUTTER SIZES: 9¼ IN. AND 12 IN. DIAMETER INSERTED TOOTH FACE MILLING CUTTERS.
CUTTER SPEED: 185 S. F. P. M.
STOCK REMOVED: ⅛ INCH.
LUBRICANT: 1 PART SUNOCO TO 16 PARTS WATER.



Courtesy of National Acme Company, Cleveland, Ohio

OPERATION: GRINDING TWO DIAMETERS AT ONE SETTING.
MACHINE: BROWN & SHARPE NO. 30 CYLINDRICAL GRINDER
MATERIAL: STEEL FORGING TYPE EE.
SPEED: 900 R. P. M.
WHEEL: CARBORUNDUM
WHEEL-DIAMETER: 30 IN. X 28 IN.
WIDTH OF WHEEL: 4 IN.
LUBRICANT: 1 PART SUNOCO TO 60 PARTS WATER.

Hot-Indenting With a Combination Punch Press and Electric Welder

An Unusual Operation On a Refrigerating Unit Part

By AVERY E. GRANVILLE

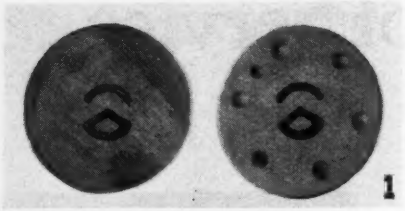


Fig. 1—Pump caps after indenting, in the rough and after being drilled and ground.

IN the making of the steel cap for the rotary pump body which forms a part of the refrigerating unit made by the Majestic Household Utilities Corporation, a number of unique operations are involved.

This steel cap, shown in the rough state at the left in Fig. 1 and in the finished form at the right, is made of 1350 S.A.E. Std. steel, approximately 3⅛ in. in diameter in the rough and $\frac{1}{16}$ in. thick. Of the several operations that are performed on this piece, that of indenting is the most interesting, due to the manner of combining two machines to obtain the desired results. The indentations are fluid ports, in cross-section something like a bellied V, about $\frac{1}{32}$ in. deep and the same across the top, or widest part.

The curved indentation is approximately 1 in. long, measured on the curve. The curve of the other indentation is the same, with the sides of the triangle each $\frac{5}{8}$ in. long. Exact dimensions are not given because the dimensions vary somewhat from start to finish, and those given are close enough to bring out, to the practical mechanic, the difficulties of the work. A little checking up will soon convince anyone that the production of indentations of this size and shape, in steel of the specifications given, at a speed commensurate with large unit production, and at a cost within reason, is no simple job.

As routed at present, the sequence of operations is as follows:

1. Blank .....Minster Press
2. Flatten .....Minster Press

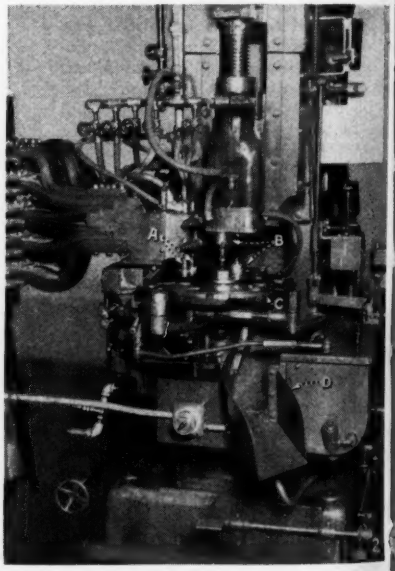
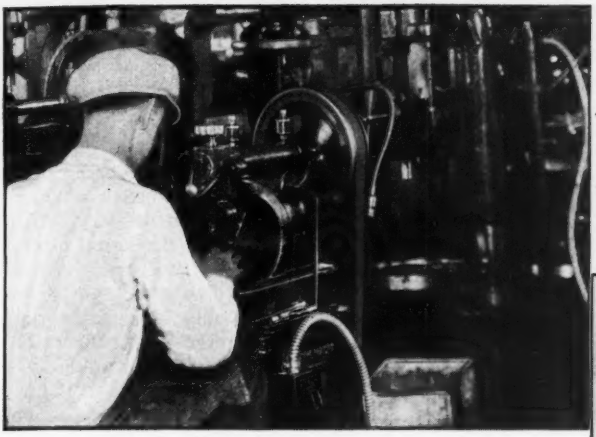
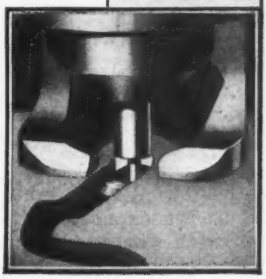


Fig. 2—Combination heating and indenting machine.





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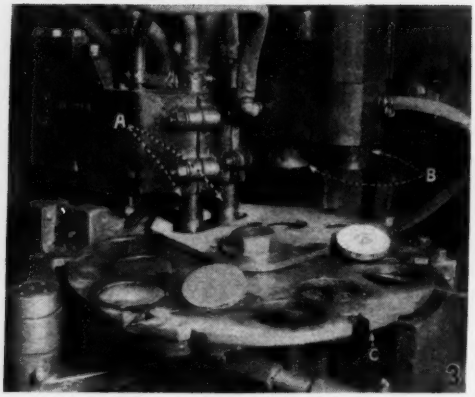

Fig. 3—Close-up view of the indexing disk, electrodes, and punch-holders.

3. Indent .....Kobert Machine
4. Grind sides .....Blanchard Grinder
5. Drill and ream 20 holes.....
.....Edlund-Kreuger Machine
6. Drill five No. 33 holes, four Q holes, and one ¼-in. hole.....
..... Barnes-Kreuger
7. Grind burs .....Kingsbury
8. Carburize .....Heat Treat
9. Turn O. D. .....LeBlond Lathe
10. Drill one ⅛-in. horizontal hole and one ⅛-in. vertical hole.....
.....Kingsbury
11. Counterbore two Q holes.....
.....Edlund-Kreuger
.....Taylor & Fenn
12. Burr and clean.....Bench
13. Harden .....Heat Treat

In making the blanks, it was decided that to cut them from bar stock would be too expensive; there would be too much waste in cutting off, the process would be too slow, and the handling of the bars, the added equipment, and all would involve too much labor and expense. So it was decided to punch the blanks from flat stock.

After being punched out and flattened, the steel disks are ready for the indenting operation and here, as has previously been stated, is the real problem. Speed, accuracy, production and cost all had to be considered and carefully taken into account.

To produce a recess or indentation such as is required to conform to specifications, in steel, with a vertical milling machine or other similar machine, would be very difficult on account of the small size of the end mills that would have to be used. The breakage of the cutters would be sure to be high; the tendency of such small cutters to spring would cut down accuracy and speed; and, altogether, any form of machining seemed out of the question, except as a last resort.

Lucien I. Yeomans, consulting engineer, suggested the plan which was finally adopted and is now in use. His suggestion was to electrically heat the centers of the blanks and press in the indentation with a punch of the proper shape. A Kobert machine built along the lines suggested by him is shown in Fig. 2. The machine is a combination automatic-feed punch press and double-electrode heater similar in design to a spot-welder.

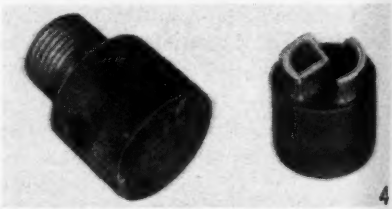

Fig. 4—(Left) Copper Electrode and (Right) Indenting Punch.

In performing this operation, the blanks to be indented are placed by hand into holes in a large rotary feeding disk, which is automatically rotated, or indexed, two holes at a time. With a blank in position under each

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Baltimore, Md.
Harry A. Moore, Bangor, Me.
The Union Gear & Mch. Co.
Boston, Mass.
The Atlantic Gear Works
Brooklyn, N. Y.
Chicago Rawhide Mfg. Co.
Chicago, Ill.
Perfection Gear Company
Chicago, Ill.
Chicago Gear Company
Chicago, Ill.
The Cincinnati Gear Co.
Cincinnati, O.
The Greaves Machine Tool Co.
Cincinnati, O.
The Horsburgh & Scott Co.
Cleveland, O.
The Stahl Gear & Machine Co.
Cleveland, O.
The Master Electric Co.
Dayton, O.
Enterprise Tool & Gear Co.
Detroit, Mich.
The Adams Company
Dubuque, Ia.
Hammer Machine Works
Fort Smith, Arkansas
The Ferguson Gear Co.
Gastonia, N. C.
Excello Machine Co.
Grand Rapids, Mich.
Hartford Special Mchny. Co.
Hartford, Conn.
Precision Machine Co.
Milwaukee, Wis.
H. C. Brelie, Milwaukee, Wis.
Joaquin Alemany Lopez
Havana, Cuba
The Dedman Foundry & Machine Co., Houston, Tex.
The Generating Gear Co.
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The E. A. Pynch Co.
Minneapolis, Minn.
Mobile Pulley & Machine Wks.
Mobile, Ala.
Berkley Machine Works & Foundry Co., Norfolk, Va.
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Meisselbach-Catucci Mfg. Co.
Newark, N. J.
Sier-Bath, Inc.
New York City, N. Y.
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Peoria, Ill.
The Earle Gear & Mch. Co.
Philadelphia, Pa.
Lamont Gear & Mch. Co.
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Arlington Machine Co.
St. Paul, Minn.
Diefendorf Gear Corp.
Syracuse, N. Y.
Worcester Gear Works
Worcester, Mass.
Massachusetts Gear & Tool Co.
Woburn, Mass.

of the two copper electrodes, the electrodes are pressed to the blanks and a spot approximately 1½ in. in diameter in the center of each blank is heated to a good red. The indexing mechanism then carries the two heated blanks to position under the two indenting punches, and thence around to the point where they drop out of the carrier and down the chute shown in front of the machine.

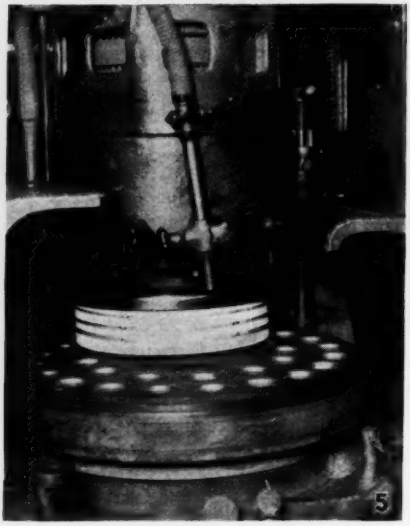

Fig. 5—Work-Holding Disk, Electrodes and Punch Holder.

In Fig. 2 the two moveable electrodes are shown at **A**, and the two holders for the indenting punches at **B**. The work-carrying disk is indicated at **C**, and the chute at **D**. The hose and connections shown around the ram and electrode holder are for the circulation of water for cooling purposes. A close-up view of the ram, electrodes, and disk is shown in Fig. 3. The production on this operation is approximately 8 pieces per minute, or four blanks per plunger. One of the copper electrodes is shown at the left in Fig. 4, and an indenting punch at the right.

The surfaces of the blanks are ground, after the indenting operation, in the Blanchard grinding machine shown in Fig. 5. The table is ordinarily surrounded by a hood, the doors of which have been thrown back in order that the work-holding disk may be seen. The holes are drilled and reamed in vertical-spindle, rotating-table automatic machines, then the burs are ground off, the pieces are carburized, and the diameters are turned to size.

The turning operation is performed in an especially-equipped LeBlond lathe, shown in Fig. 6. In this machine the piece to be turned is chucked on the drive spindle by means of the two pins **A**, which enter two of the holes in the blank. The tailstock spindle is then brought forward, pressing the disk **B** firmly against the face of the blank. This disk turns on ball bearings and is free to rotate with the blank. The tailstock spindle operating lever **C** is made so that turning the handle not only moves the disk up against the blank, but also firmly locks it in place during the turning process. Reversing the handle unlocks

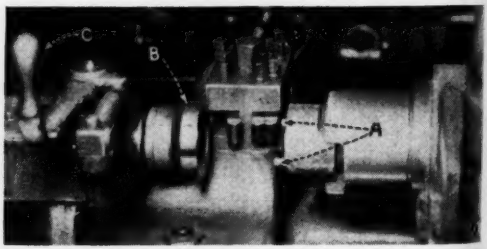

Fig. 6—View showing method of locating work in LeBlond lathe.

(*Continued on page 32*)

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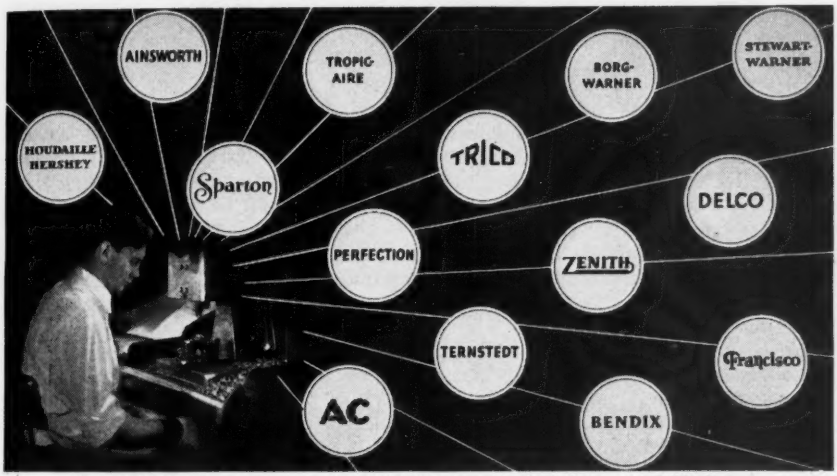

Where production warrants, a foot press can be used instead of a hammer to drive in Hardened Metallic Drive Screws.

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Factors That Influence Milling Costs

— *A Few Pointers on Milling Machine Set-Up and Operation*

By R. H. KASPER

THE reduction of machining costs is a subject that is given considerable thought, is discussed widely, and neglected frequently. In plants where a standard product is produced, where parts by the thousands are made daily, special departments are maintained for planning methods whereby machining time may be held to a minimum. Jigs and fixtures costing hundreds of dollars are designed to save a fraction of a minute in machining or handling time. It is due to this systematic study and planning that many of the products on the market today are held to costs within easy reach of the multitudes. However, where parts are made in small quantities, the cost of elaborate fixtures is prohibitive; the contract shop or the shop producing more or less special parts must build its estimates around the present equipment. As the majority of shops fall in the latter class, this discussion will be given from that angle, the design and use of fixtures being disregarded.

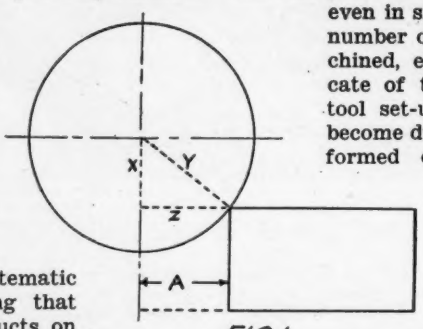
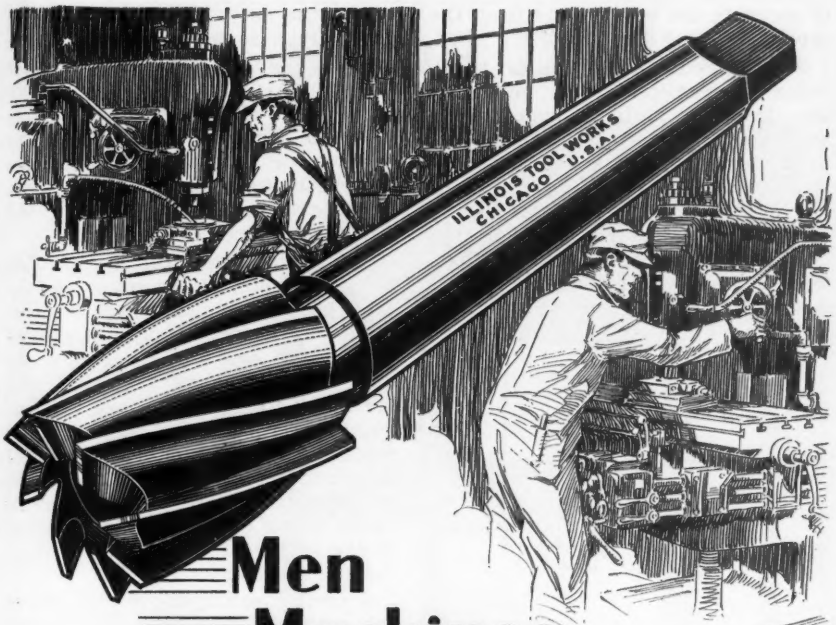


FIG. 1.

Outside of material costs, overhead expense, sales expense, and so on, the cost of each part depends upon the time required to machine it, plus the handling time. As handling time can seldom be lowered without the use of a fixture of some sort, and as there are certain variables, such as the shape of the parts and their flexibility, which influence the handling time, discussion will be confined entirely to actual machining time.

The milling machine lends itself admirably to the duplication of parts, even in small quantities. Any number of parts may be machined, each an exact duplicate of the other, with one tool set-up until the cutters become dulled. By the use of formed cutters, various shapes may be machined and, after the set-up has been completed, the accuracy of the work will not depend upon the skill of the operator. Nevertheless, failure to secure the highest efficiency from the milling machine is due to overlooking a certain few points.

When gang milling is done with cutters of different diameters, the speed of revolution of the machine arbor is governed by the diameter of the largest cutter, while the feed of the table is governed by the diameter of the smallest cutter. As the machining time is directly dependent upon the feed of the table, the smallest cutter is therefore the controlling factor. However, it is the design of the part which dictates the use of large and small cutters; it is therefore desirable to determine upon a method



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MAJOR factors of production costs too often overshadow seemingly small items which really are of equal importance. Small tools, for instance, such as Milling Cutters, Hobs, Reamers, and Broaches—a big factor in cutting costs—are often overlooked.

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of securing the best results from the combination.

Assuming the large cutter to be twice the diameter of the small cutter, the larger cutter is operating at approximately one-half efficiency, due to the reduction of the feed, while the smaller cutter is operating at a similar loss of efficiency, due to the reduction of the speed. Though the design of the parts indicates the differences in the diameters of the cutters to be used, it does not influence

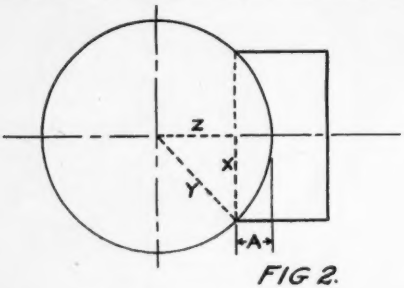

FIG 2.

the actual choice of cutter diameters, other than to indicate the smallest diameter cutter which can be used to secure the required depth of cut. In order to neutralize as far as possible the bad effects of varying cutter diameters, the entire set of cutters should be of a larger diameter, while still retaining the required differences in diameters. Twelve and eight-inch cutters can be used more efficiently in combination than four and eight inch cutters; though the difference in the diameters is the same, the ratio between the two diameters is lower, therefore both cutters can be operated at more nearly the most efficient speed and feed.

In all cases, except when the work is fed directly into the cutter, as when feeding vertically under the cutter, there is a certain portion of the travel during which the cutter is not working at its full capacity. In other words, the cut starts from zero and gradually becomes greater until the leading edge of the work reaches the center of the cutter. Though this portion of the cut is not entirely lost, this distance, commonly called the overrun of the cutter, increases the length of table travel necessary to pass the cutter through the work, and should be held to a minimum.

Overrun of the cutter is controlled by the diameter of the cutter and the depth of the cut; the larger the cutter and the deeper the cut, the greater will be the overrun. In Fig. 1 the work has been brought forward until the upper edge just touches the cutter. The full depth of the cut is not reached, however, until the edge of the work reaches the position shown by the dotted lines. The distance A, which is the overrun, must be added to the length of the work to obtain the table travel.

A comparison of the same depth of cut with different diameter cutters will prove enlightening. The overrun may be computed by solving for the base Z of the triangle XYZ. The side Y is equal to the radius of the cutter, while the side X equals the radius of the cutter minus the depth of the cut. The formula therefore becomes $Z=\sqrt{Y^2-X^2}$. Assuming the diameter of the cutter to be 4 in. and the depth of the cut 1 in., the overrun will be $\sqrt{3}=1.732$ in. With a 6-in. cutter, the overrun will be $\sqrt{5}=2.236$ in. With an 8-in. cutter, the overrun will be $\sqrt{7}=2.645$ in. Thus it will be seen that a 6-in. cutter increases the length of table travel more than ½ in. over the 4-in. cutter, while the 8-in. cutter increases the length of travel almost another half inch. Though this may be classed as an extreme case, it is not uncommon.

If we assume a gang milling set-up with both large and small cutters on the same arbor, we have a condi-

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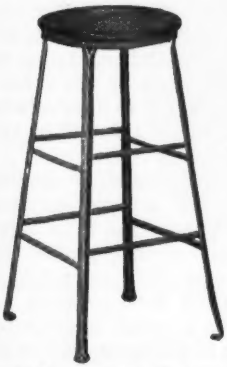

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tion which tends to slow up the work considerably. First, the r.p.m. of the arbor is held to within the maximum permitted by the diameter of the large cutter, thus reducing the efficiency of the small cutter; second, the feed is set to best suit the small cutter, thus reducing the efficiency of the large cutter, and, third, the overrun required by the large cutter slows up

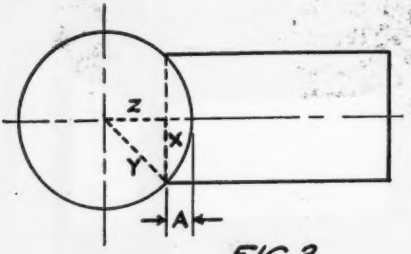

FIG. 3.

the entire operation. Such instances are not infrequent, and are generally accepted as uncontrollable, but careful study will in some cases prove that it would be more economical to use more than one operation, so that each would be operating under more efficient conditions. This, however, depends upon the time required for setting the work and the machine; if the set-up time is high, the most economical method may be to use one set-up at the lower speeds.

In face milling, the question of overrun again enters into the decision. However, there is one difference in that there is frequently a choice of two directions in which the cutter may pass over the work. Ordinarily, in face milling, an entire surface is machined, and, unless the shape of the work prohibits, there are no limitations as to the direction of the feed. Here, also, it is advantageous to use small-diameter cutters for the sake of reducing the overrun, though the question of direction will be found of equal importance.

In Fig. 2, an 8-in. face mill is used to machine a surface 3x6 in., the job being set up to feed in the direction of the narrow sides. The overrun is found by solving for the side Z of the triangle XYZ, and subtracting the result from the radius of the cutter. Applying the formula $Z=\sqrt{Y^2-X^2}$, the side Z equals 2.645 in. Subtracting from the radius of the cutter, the overrun A will be 1.355 in. Adding to this the length of the side of the work (3 in.), the total travel of the table will be 4.355 inches.

In Fig. 3 the work has been turned so that the feed will be in the direction of the longer side of the work. In this case, the overrun will be 0.678 in., which, added to the length of the surface, gives a total travel of 6.678 in. In spite of the reduced overrun, the total travel required in Fig. 3 is approximately 50 per cent greater than in Fig. 2. However, due to the smaller diameter of the cutter used in Fig. 3, the arbor speed can be double that of Fig. 2, and, assuming the feed per revolution to be the same in both cases, the saving in time effected by milling the longer cut will be very well worth while.

The practice of "nursing" the cutters is one which greatly increases the machining time. The most highly skilled mechanic cannot predict just how many pieces may be machined before the cutters need grinding. If the lot of parts is small and the set-up difficult, it is to advantage to operate the cutters as long as possible without dulling them, but with fairly large lots, it is well worth while to sacrifice the cutters in order to decrease the machining time per piece.

Let us assume a job of 1,000 pieces to be machined, each piece requiring 2 minutes, the set-up requiring 30 minutes. If the feed and speed is such that the cutters will require grinding but once in the production

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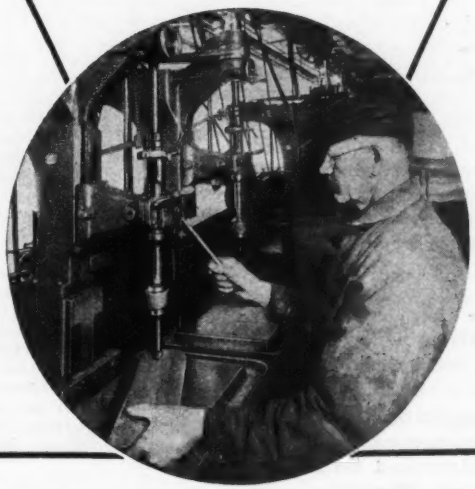

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of the entire lot, the total time required to machine the lot will be 1000 x 2 + 30 = 2030 minutes. Dividing by 1000 gives a time of 2.03 minutes per piece. If, now, the speed or feed is increased so that the cutters will require grinding after 500 pieces are machined, the actual machining time per piece will be reduced 50 per cent. This latter statement is theoretical; it may not be possible to reduce the time to such an extent. Nevertheless, if a cutter can machine 1000 pieces without becoming dulled, it is safe to assume that the feed or speed could be increased. Be that as it may, the example will serve to emphasize the point. The total time per piece now becomes 500x1+30, dividing by 500 gives 1.06 minutes per piece total machining time in lots of 500 at the increased rate of feed or speed. Theoretically, the most economical number of pieces which could be machined per cutter grind would be slightly below that point at which the time of grinding the cutters would over-balance the time gained by the increase of feed or speed. Practically, it is impossible to come within a wide range of this point, as there is a certain speed and feed beyond which it is impossible to pass without ruining the cutters entirely.

The question might be asked as to how the most economical feed and speed may be determined before the machining is started. There is no rule which can be given, as much depends upon certain conditions which vary with practically every operation. Experience must serve as a guide, or, if conditions warrant it, a trial set-up for experimental purposes will be the most accurate guide.

The foregoing by no means covers all the points worthy of consideration when planning machining operations, but the points discussed have been found to be frequently overlooked or regarded as uncontrollable. The examples given, however, must not be accepted without reservations; it is well to bear in mind that in most machining operations there are a number of variables which, if not observed, will upset the most carefully-laid plans.

Shop Practice Handbook Issued By Taft-Peirce

Supervisors of machine shop operations will be interested in a comprehensive 216-page handbook that has been published by The Taft-Peirce Manufacturing Co., Woonsocket, R. I. The volume is profusely illustrated and replete with data on gages, small tools, fixtures, special machines, and machine shop practice in general. The text includes a synopsis of the report of the American Gage Design Committee, with drawings and dimension tables of standards, together with other useful tables and pertinent information.

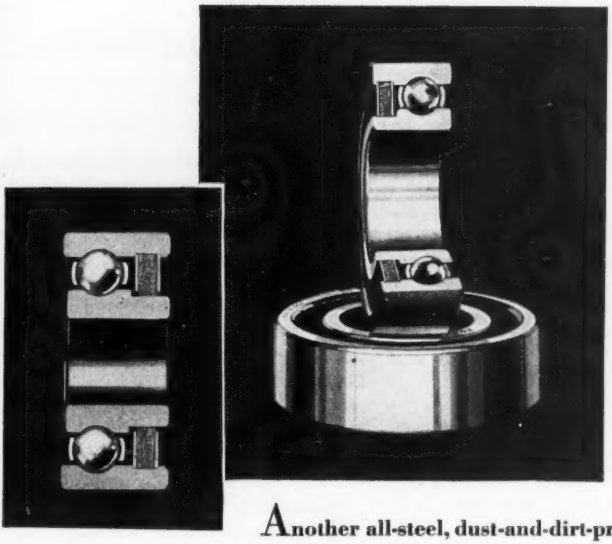
The book also contains a detailed description of the complete line of precision gages and tools manufactured by this company, as well as the extensive facilities afforded by the Taft-Peirce plant for the designing and building of special tools, machines and contract work. Included are complete details of several new products that have just been developed and that will be of particular interest to those who wish to keep in touch with the latest improvements in production and inspection equipment.

The book will be sent gratis to mechanical executives who indicate their firm and position, and mention this magazine.

Hot-Indenting With Combination Press and Electric Welder

(Continued from page 24)

the tailstock spindle and moves it back when the turning operation is completed and the blank is ready to be removed. Three tools are used, as shown in the illustration. Two of the tools are used for roughing and finishing the periphery, and the third tool is used to bevel the edge of the blank.



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Liability of Machine Shop Owner For Contracts Made By Employes

By LEO T. PARKER
Attorney at Law, Cincinnati, Ohio

FEW owners of machine shops and metal manufacturing plants underestimate the importance of obtaining insurance against damage by fire, water, and wind, yet the chances for financial loss from this source are comparatively small. On the other hand, they are few who take the precaution to eliminate the probability of expensive litigation, although it is well known that the chances for losses from this source may be serious. Such chances can, however, be greatly reduced through knowledge of the basic principles of the law.

The purpose of this article is to review recent higher court cases involving the liability of machine shop owners for contracts and agreements made by employes. Where it is practical to do so, the exact words of the Court will be cited, thus assuring readers of thoroughly dependable information.

Classes of Employes

First, it is important to know that the law recognizes two classes of agents or employes; namely, general and special. A machine shop manager, for instance, is a general agent, because he is employed to perform all acts necessary to the successful conduct of the business. A workman is a special agent whose authority is limited to the performance of a single act or the *special service* for which he is hired. Obviously, however, the accomplishment of this special service may include the performance of many other acts of making binding contracts and guarantees, providing the employer confers upon him a special agency. For this reason, it is well settled that an employer is bound by all contracts, agreements and promises made by his special agents, if it is proved to the satisfaction of the Court that the employer directly conferred *additional* authority on this class of employes. The same law is applicable if the employer performed any act by which his customers were led to believe that the employe was empowered with unusual authority.

Scope of Employment

Generally speaking, an employer is legally responsible for all contracts made by his employe while the latter is acting "within the scope of the employment." On the other hand, this statement should not be understood to mean that the employer is liable for all acts performed by the employe "during the period of the employment," because the latter term means the actual period each day the employe is paid to perform his regular duties. However, an employe need not be in the act of rendering services to his employer to be legally within the scope of the employment.

For instance, it has been held that an employer is liable for all contracts made by a manager which relate to the former's business, or department of the business which he manages, provided the other party to the contract has *not* been notified by the employer that the manager's authority is limited.

Therefore, ordinarily the owner of a machine shop is liable for any con-

tract, agreement or promise made by his manager to a customer with respect to the cost, delivery or completion of work. Also, the proprietor is liable if previously he has given a common employe authority to contract with a customer and the latter is not notified that the authority was specially granted to the employe.

Employe Exceeds Authority

Obviously, however, an employer is not liable on contracts made by a person who represents himself to be a manager when such representation is unwarranted. In other words, a person contracting with an employe who states that he is properly authorized to make contracts is bound to inform himself that such representation is true, otherwise the employer is not liable. Therefore, a person who files suit against a machine shop owner for compensation on a contract made by a person who said he was a manager is bound to prove that the latter actually was employed by the employer in that capacity.

For illustration, in State Co. V Turrentine, 21 S. W. (2d) 344, decided recently, it was shown that a person named Goss went to a printing establishment and said that he was the manager of the State Company. He ordered a large quantity of specially printed advertisements. Later the officials of the company refused to pay the printer's bill on the contention that although Goss was a company employe, he was not the manager and was not authorized to make the contract. Although the lower Court held the company liable for payment of the printer's bill, the higher Court reversed the verdict, stating as follows:

"It is a well-settled rule of law that the declarations of an alleged agent are not admissible against the alleged employer to prove agency or to show the extent of the purported agent's authority. . . . . That the declarations of the agent are incompetent to prove agency is so well settled that it is unnecessary to cite authorities. . . . . Persons dealing with an assumed agent . . . . are bound, at their peril, to ascertain not only the fact of the agency, *but the extent of his authority*. . . . . Since there is no evidence in the record authorizing the Court to find that Goss in making the contract for the printing was the agent of the State Company . . . . we conclude that the . . . . judgment of the trial Court is reversed."

Another interesting phase of the law on this subject relates to the liability of an employer for payment of money borrowed by the manager of his business. Generally speaking, a manager does not act within the scope of the ordinary employment when he borrows money for use of his employer's business, unless he is given full control and operation of the business. And then the owner of the business is not liable if the manager borrows the money for purposes other than for operation of the machine shop business.

Liability for Signatures

Contrary to the opinion of the majority of persons, the owner of a business is liable for any form of signature, such as that made with a rubber-stamp, typewriter, initials, or other symbols, providing the employe is impliedly or expressly authorized to affix his employer's signature to the instrument in controversy.

For example, in the leading case of Mayers V McRimmon, 53 S. E. 447, the higher Court considered the legal rights of an employe to bind his employer by imprinting the latter's name on a note with a rubber-stamp. This Court explained the generally established law on the subject as follows:

"Where the name required has been so placed by one having authority to do it and *with intent* to indorse the

instrument, the authorities hold that this is a valid indorsement."

Moreover, it is immaterial whether an employer or his authorized employe signs a contract with a full name or with initials, providing the employer intended to be bound when the signature was affixed, or the employe had proper authority to make the contract.

For illustration, in the leading case of Meaton V Meyers, 33 Ill. 424, an authorized employe signed a contract "H. C. M." Litigation developed over the validity of the contract. After carefully considering the testimony, the Court held the employer liable, and explained that any person, or his authorized agent, may complete a valid legal obligation by using *any* form of signature or mark, if the same is substituted for the signer's name *with intentions to bind the employer*.

Obviously, however, an employer is not liable for contracts signed by an employe simply because he places in his employe's possession rubber-stamps or other mechanical signing devices. In other words, coupled with the evidence that the employer gave a mechanical signing device to an employe must be convincing testimony that the employer impliedly authorized the employe to make valid obligations, otherwise the employer is not liable.

Also, it is established that the party who files suit on a contract or other instrument signed with a rubber-stamp, typewriter, or initials, is bound to prove that the signature was affixed by the employer or his authorized agent with intentions of making an enforceable obligation.

When Employe Is Personally Liable

Although the owner of a machine shop is personally liable under various circumstances for contracts, agreements and promises made by his employe, it is interesting to observe that the employe may also be personally liable to his employer or his employer's customer.

After thoroughly reviewing the leading higher Court cases on this subject it seems settled law that an employe may be personally liable on contracts made for his employer, (1) where he makes a false statement or representation of his authority with intent to deceive; (2) or, where he knowingly makes a false statement or representation, without intent to deceive; (3) or, where he does an apparently damaging act believing he has authority, but actually has none; (4) or, where he acts on authority from his employer and does an unlawful act; (5) or, where he assumes responsibility without authority of his employer; (6), or where he signs his own name to a contract without clearly binding his employer.

In other words, there are many circumstances under which an employe is personally liable for affixing his signature to contracts. Sometimes his employer is liable, also, but as a general rule where an employe exceeds his authority and performs an act outside the scope of the employment, the employer is relieved of liability.

For instance, in Kidd-Russ Co. V Meyer, 123 So. 506, it was disclosed that an employe signed an order for materials for use in a corporation's business. The seller filed suit against the employe instead of the corporation. It is interesting to observe that the higher Court held the employe personally liable, saying:

"The purchases were made by defendant (employe), who did not disclose that he was acting as the agent of the corporation, or that any part of the merchandise was for the use of the corporation. . . . . We are of the opinion that under the evidence the Court properly applied the general rule that one acting as agent for an-

(*Continued on page* 48)

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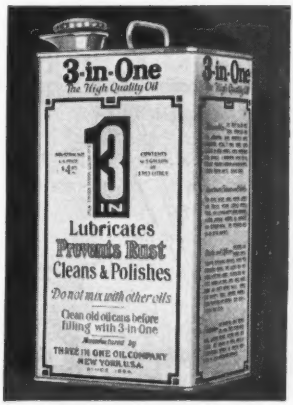

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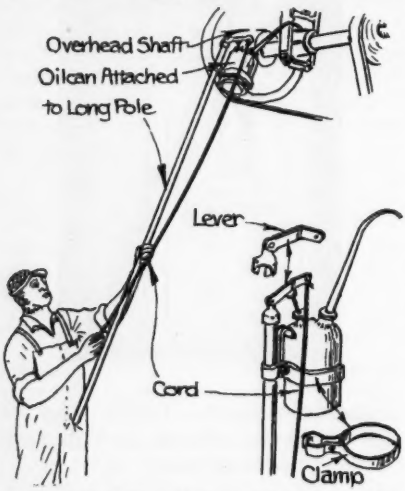
Ideas From Readers

This department is a clearing house for ideas. If there is a "kink" or short cut in use in your shop, send in a description of it. We will pay $5 for each one published.

A "Home-Made" Overhead Shaft Oiler

By MORRIS A. HALL

WITHOUT the proper equipment, the oiling of overhead line shafts is a difficult, slow, and frequently a dangerous task. The oiler must move a heavy ladder from one bearing to the next, disturbing production, interfering with the operators, attracting the attention of those who may not be directly concerned, forcing suspension of work by others while he leans the ladder over their machines, and risking his neck by climbing the ladder while the bottom is located on a slippery floor and the top end is leaned perilously against a line shaft hanger. Patented oilers are now available for this job, but in the absence of such equipment, the outfit shown in the illustration will do very well.



"Home-Made" Plunger-Type Line Shaft Oiler and Method of Using.

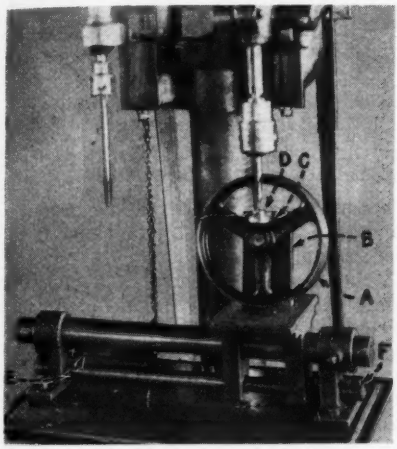
A "pump" oil can is obtained and attached to the end of a 10-ft. pole. The can must have a long, curved spout, as shown in the illustration. A clamp can easily be made of strap iron to hold the can in position, the strap being bent to fit around the can and around the pole, with a flat place between through which a hole can be drilled and a clamping screw or bolt can be inserted. A short lever is made and pivoted to the top end of the pole so that the lever will extend past the top of the oil can plunger. A hole is drilled in the lever so that a cord can be attached as shown, making it possible to push the plunger in by pulling the cord. The oiler can then easily oil the bearings while standing on the floor.

An Efficient Drilling and Tapping Jig

By AVERY E. GRANVILLE

THE illustration shows a jig for drilling and tapping small cast iron pulleys, as it appears when set up for the operation. The hole is to be drilled and tapped in the hub so that a setscrew can be screwed in to aid in locking the pulley on the shaft upon which it is to be used. The pulley is indicated at **A**. The angle **B** carries a stud upon which the pulley

is located, and also carries a bracket **C** which projects between the spokes of the pulley to serve as a holder for the slip bushing **D**. The angle **B** is



An efficient drilling and tapping jig for pulleys.

tilted just enough so that the drill will clear the rim of the pulley.

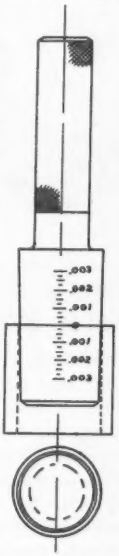
The slip bushing **D**, to which is attached a wire handle, is placed in position in the bracket **C** and the hole is drilled. The bushing is then removed and the jig is moved along on the rails until the drilled hole is under the tap. After the pulley has been tapped, it is removed and the jig is moved back to its place under the drill spindle. The stops **E** and **F** serve to locate the work properly, making careful alignment by the operator unnecessary. Any apprentice or laborer can operate this jig without difficulty.

Plug Gage For Selective Assembly

By ERNEST FOLVDARY

IN spite of all efforts toward the production of interchangeable parts, in some cases the fits are so close that selective assembly is necessary; that is, parts must be selected within certain limits to be assembled together. Selective assembly tends to slow up the job, however, especially when a series of gages are used to find the correct sizes of the parts.

In one case the selection of bearings according to internal diameter became the "bottle-neck" of production. The holes were tried with one plug gage after another until the correct size was found, and in many cases the size was questioned, due to the "human element" which necessarily entered into the gaging process.



Plug Gage for Selective Assembly.

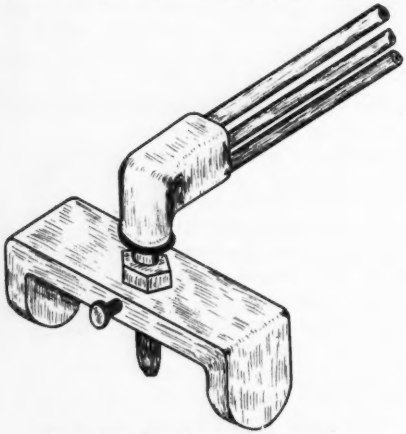
The gage shown in the drawing was made up and immediately eliminated all difficulties. The gage is tapered and graduated to quarter-thousandths, the plus dimensions over drawing standard being above the zero line, with the minus dimensions below the line. In gaging the work, the gage is inserted vertically and is allowed to seat itself by its own weight, thus eliminating the possibility of undue pressure being used to force the plug in.

Guide For the Cutting Torch

By R. H. KASPER

CLEAN, accurate cutting with the oxy-acetylene torch requires a steadiness of hand which is seldom acquired by the operator who uses the torch only occasionally. The attachment shown in the sketch acts as a support for the torch tip, holding it the required distance from the work

and enabling the operator to cut straight or irregular outlines with little effort. As the support rests on



A guide for the cutting torch.

the work, the tip will follow any irregularities on the surface of the work. The support consists of a piece of steel, bent or machined to provide a straight body with a leg at each end. The legs should be of the same length. A hole is tapped in one side at the center, so that a set or thumb screw can be threaded in with which to lock the guide in position on the tip.

Centerless Grinding Cylindrical Parts With Irregular-Shaped Ends

By V. C. HUNTINGTON

CYLINDRICAL parts with plain ends are usually fed to the centerless grinder by gravity, the parts being placed in a guide or chute in which each piece in turn is fed to the grinding wheel by the weight of the pieces behind it. But when parts with irregular-shaped ends are to be ground, it is usually necessary to feed the pieces to the wheel by hand, one at a time, so that the end of one piece will not engage with the end of the next piece and throw the piece off

Fig. 1 Fig. 2

Fig. 1—Drawing of Work-Piece. Fig. 2—Collar Used to Keep Work-Pieces in Line.

center in such manner as to produce a variation in diameter or cause it to be ground out-of-round.

The drawing illustrates a method that was developed in one plant for grinding parts with irregular-shaped ends. In Fig. 1 is shown the part that was to be ground, the tolerance being 0.0005 in. In Fig. 2 is shown an adapter collar of approximately the same diameter as the work, with a hole sufficiently large to allow the

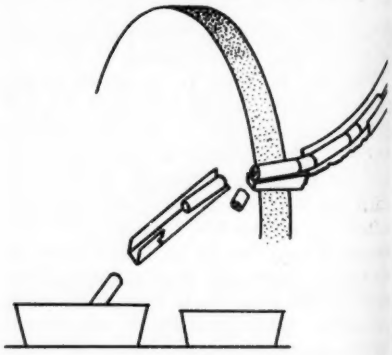


Fig. 3

Fig. 3—The parts pass on into the delivery chute while the collars fall through the opening.

end of the work to enter and long enough so that the ends of two work-pieces, entering from each end, will

(*Continued on page* 45)

Ideas From Readers

(*Continued from page 40*)

not meet. In Fig. 3 is shown the arrangement of the chute, carrying the work-pieces past the grinding wheel, and the pans into which the work-pieces and collars fall as they leave the wheel.

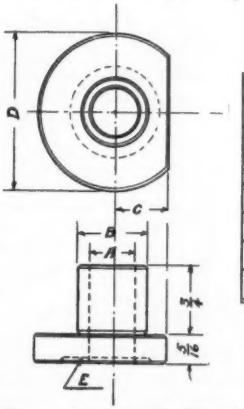
The parts and collars are placed in the chute alternately, feeding to the wheel by gravity, as explained above. The collars slip over the ends of the work-pieces and keep the pieces in line. As the work feeds past the wheel it passes into another chute by which it is carried to the proper receptacle. The upper end of this chute is located just close enough to the wheel so that it will catch the work, but far enough away so that the short collars will drop through the intervening space into a box that is placed in position for that purpose. The use of the collars reduced the cost of grinding on this operation by 75 per cent, and the parts are finished as accurately as by the in-feed method.

Uses of the Boring Disc

By ADRIAN F. MOUGEY

ONE of the most useful pieces of tool equipment that the writer has seen in the course of many years of experience as a toolmaker and toolroom foreman is a disc, which, for want of a better name, we will call a "boring disc." The boring disc is made of tool steel, hardened, ground, and lapped to the sizes given in the drawing, Fig. 1, plus 0.0003 in. on the diameters to allow for reamer-clearance. It can be made in any sizes that will best suit the requirements of the user, but I have always used the sizes listed in the table. The dimension **A** is the bore, **B** is the hub, **C** is the dimension from center to the flat side of the disc, which is used to get close to corners or as a guide against a straight edge or the end of a gage block. **D** is the diameter and **E** is the clearance on the under side, which should be approximately $\frac{1}{16}$ in. deep.

The utility of the boring disc can be increased by the use of a set of



A	B	C	D	E
.312	.600	.550	1.600	.800
.375	.650	.600	1.650	.850
.500	.700	.650	1.700	.900
.750	1.000	.700	1.950	1.200
1.000	1.250	.850	2.225	1.450
1.250	1.500	.900	2.600	1.700
1.500	1.750	1.000	2.900	1.950

Fig. 1—Design and dimensions of the "boring disc."

slip bushings, also of tool steel, hardened, ground, and lapped, with bores of from $\frac{1}{8}$ in. to $1\frac{3}{8}$ in. by steps of 1/32 in. or $\frac{1}{16}$ in. The bushings should be made to slip into each other so that with a set of discs and slip bushings, any size hole desired, within the range of size of the bushings, can be bored.

A simple application of the boring disc can be seen in Fig. 2, where it is shown in use with a set of gage blocks to find the correct location of four holes in a drill template. The two straight edges **A** and **B** are clamped or doweled to the edges of the template at right angles and square with each other, then it is a simple matter to locate the holes from the straight edges. For example, if a $\frac{3}{4}$-in. hole were required at a point 5 inches from one straight edge and 3 inches from the other, a disc with a 0.750-in. hole

should be used. On this disc the dimension **C** from the center of the hole to the flat side is 0.700 in. Subtracting 0.700 from 3.000 in. leaves 2.300 in., which dimension is obtained with gage blocks. The **D** dimension of this disc is 1.950 in. Half of this dimension — 0.975 in. — subtracted from 5.000 in. leaves 4.025 in., which is the dimension that must be obtained with gage blocks in the other direction. The disc is clamped in place at this point. If ordinary type of toolmaker's clamps will not reach, two ⅜-in. holes can be drilled and tapped so that a couple of flat clamps can be used with parallels. Any number of holes can be located in the manner described above, and if care is taken, it should be a simple matter to hold the dimensions within a limit of 0.001 in. By using this method, I have located and bored five holes in a drill jig in 30 minutes.

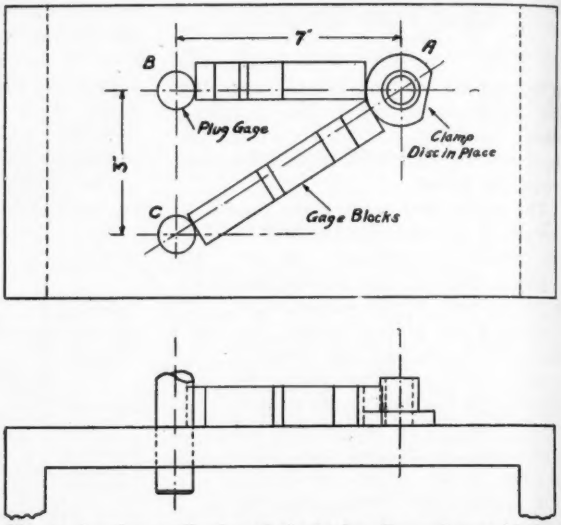


Fig. 3—Another application of the boring disc and gage blocks.

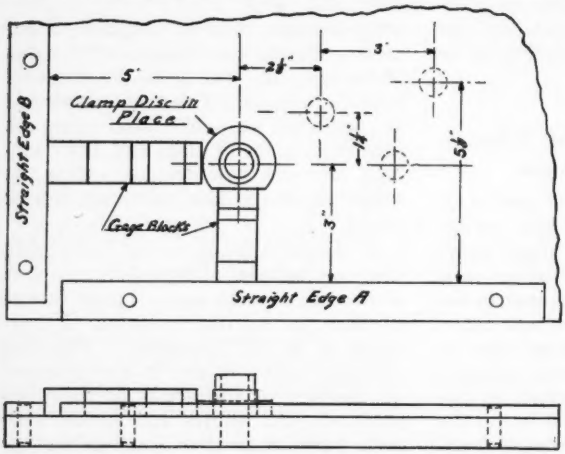


Fig. 2—Locating holes by using the boring disc and gage blocks.

Figure 3 shows the plan of a jig in which three holes are to be bored. The hole **A** is bored first, the holes being located by clamping the disc in approximately the correct position. A plug is then put into this hole and the disc and gage blocks are used to obtain the correct location of the hole **B**. When this hole is bored, a plug gage is inserted and the disc is used to locate the hole **C**. The dimension between the centers of the holes **B** and **C** is 3 in., and the dimension between the centers of the holes **C** and **A** is the hypotenuse of

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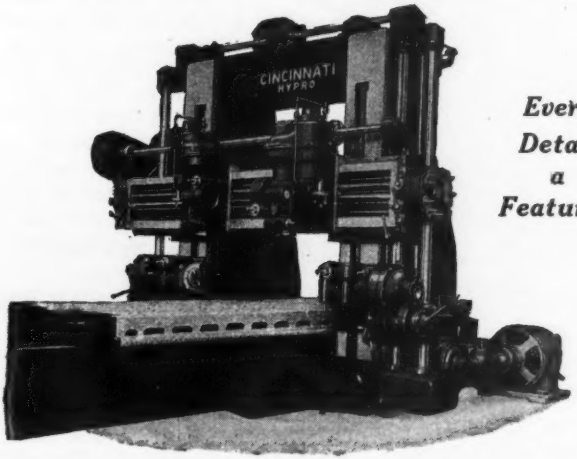

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the angle **A B C**, which is 7.622 inches.

In Fig. 4 is shown the plan of a drill jig in which the holes have been laid off with a Vernier height gage.

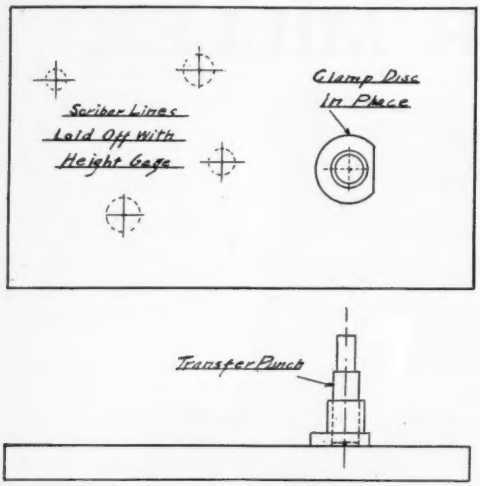


Fig. 4—Using the boring disc with a height gage and transfer punch in laying off work.

A very small center punch mark is made where the lines intersect, then a transfer punch is slipped into the hole in the disc and the point of the punch is located in the punch mark. With the disc thus located, it may be clamped in place and the hole drilled and reamed. This method will prove satisfactory where accuracy of not more than 0.0002 in. is required.

If the job requires the setting of toolmaker's buttons in order to obtain extreme accuracy, they may be placed in the usual manner, then a bushing the size of the button is slipped into the disc and the disc is located over the button and clamped in place. The button is removed with the bushing and the job is ready for boring.

Occasionally it becomes necessary to enlarge a hole in a drill jig or fixture. This task can be simplified in some cases by slipping a plug gage into the hole, after the old bushing has been removed, and using a slip bushing and disc to obtain the location. After the plug gage and bushing have been removed, the hole is bored without losing the alignment.

The toolmaker will find that with a small amount of practice he will be able to do fairly accurate work by the use of the disc. The disc is not intended, however, to take the place of a standard jig-boring machine. Rather, it is recommended for use in shops where the amount of tool work done does not warrant the installation of jig-boring equipment.

Liability For Contracts

(*Continued from page 36*)

other is personally answerable if he fails to disclose his principal."

At present the law is well established that an employe is relieved from all risk of personal liability on contracts which he signs for his employer with proper authority, provided: (1) the name of his employer appears in the body of the contract, or on the letter-head; (2) the word "By" or "Per" precedes his signature; (3) word "Agent" or "Manager" follows his signature; (4) and the employer's name precedes the agent's signature, as follows:

"The G. W. Smith Company,
per W. C. Smith, Agent."

Hardinge Brothers Move

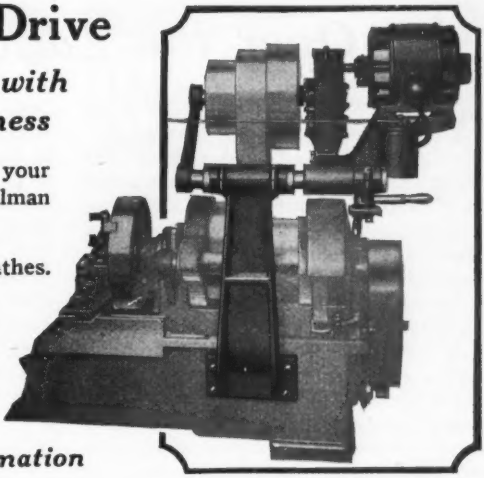
Hardinge Brothers, Inc., manufacturers of precision bench lathes, tool room lathes, bench milling machines and collets, have moved their general offices and factory from Chicago to Elmira, New York, where a new plant has been built.

Cullman Lathe Drive

A Motor Drive Unit with Belt Drive Smoothness

MOTORIZE and modernize your cone pulley lathes with Cullman Lathe Drives.

Quickly and easily attached to lathes. Only four bolt holes needed. Made for motors from ¼ to 7½ h.p., for lathes from 8" to 36". Also made for Shapers and Milling Machines.



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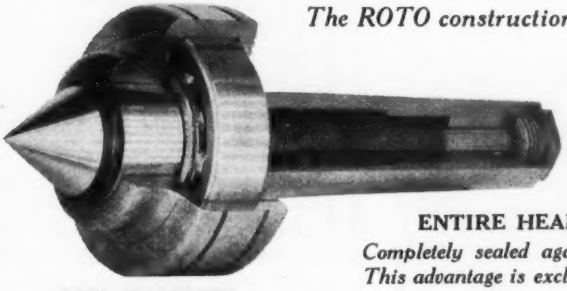
Incorporating new mechanical principles, never before applied to centers, which completely eliminate all difficulties experienced with previous types.



The ROTO construction greatly increases

LOAD
CAPACITY
LIFE
ACCURACY

ENTIRE HEAD REVOLVES

Completely sealed against dirt and water. This advantage is exclusive with the ROTO.

SPECIAL CENTERS

Furnished, either Point or Shank, to blue print.

Write For Details

TOOL CLEARANCE

Note construction, which allows this type to be used where ordinarily tool clearance would prohibit use of other types.

A. H. PEARSON 7 EAST GRAND AVENUE DETROIT, MICHIGAN

Over the Editor's Desk

AN interviewer quotes Henry Ford as stating that he is looking forward to the coming of prosperity that "will make all previous prosperity look small." Whatever his status as a prognosticator, Mr. Ford is suiting his action to his belief. The Ford Motor Company reports (November) that it is hiring former employes at the rate of between 1,000 and 1,200 per day. Due to the fact that this company receives a telegraphic report on conditions from each one of its dealers every ten days, it is probably in closer touch with actual conditions throughout the country than anyone else. So if Ford is re-hiring, it is because he thinks the time for action is ripe. * * * Other auto manufacturers are apparently of the same mind. The Buick plant is reported as on full time, and the other plants in that section are increasing their forces or working time, or both.

It is interesting to note the prestige that has accrued to the automotive industry, considering its youthfulness. But that is as it should be; power transportation is responsible for the employment of more people than any other single factor. It has brought about the building of thousands of miles of fine roads where "mud" roads existed before; it has made possible the scattering of population instead of congestion; it has changed the reckoning of distance from miles to minutes. It is a powerful leader.

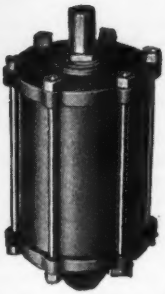
SO MANY favorable comments were received on Professor Enos's articles on "The Nature and Properties of Iron and Steel," which were published in MODERN MACHINE SHOP in 1929, that we have prevailed upon Mr. Enos to give us some good, practical material on "Characteristics of Alloy Steels." The first article appears in this issue, and there will be two—or possibly three—more. The first one deals largely with the scientific aspects of the subject, but as the series goes along, it gets right down to a practical discussion of what alloy steels will do and how they should be handled. This set of articles will be both interesting and valuable to makers of tools and dies, in both large and small plants.

YOUR editor spent several days of this month at the plant of the Hamilton Watch Company, Lancaster, Pa., observing the various operations in the making of the famous Hamilton "Railroad Watches" and the more commonly-used Hamilton wrist watches. This information will be passed on to readers of MODERN MACHINE SHOP in the form of a series of articles, the first of which will appear in the January, 1932, issue. The use of sapphires as lathe cutting tools, the manufacture of screws so small that a thimble will hold 13,000 of them, the production and use of plug gages that are as small as .0028 inch in diameter, and similar fine work forms a basis for an unusually interesting story.

HERBERT N. CASSON puts it this way (via Nation's Business): "When a horse balks, the balk is in his head, not in his legs. He moves when he thinks he will. And when an American business man is depressed, the slump is in his head. To lose a bit of money is nothing, but to lose hope, nerve, and ambition—that is what makes men cripples."

"HOPKINS" PREFERRED EQUIPMENT

Chucks *and* Cylinders



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HOPKINS Non-Rotating, Double-Acting Air Cylinders (as illustrated), tubular type. Available in any required capacity. Three other styles.

Let our engineers help you on your specific problems.

HOPKINS Chucks are available in a variety of sizes. Hold work nearer spindle bearing with greater gripping power, increasing production and reducing vibration and wear on machines and tools. Dust-proof. Jaw-operating mechanism by reason of greater bearing surface insures greater centering precision for second operation.

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(Also available in two-jaw style)

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There's No Better Magnetic Chuck than a Taft-Peirce *Super* POWER

IT'S the ideal chuck for Grinders, Lathes, Planers, Shapers, Milling Machines and all Special Production Equipment requiring the holding of ferrous materials because:

1. It has greater magnetic holding power than any other chuck of same size.
2. Its working area is larger than any other chuck of same size.
3. Greater versatility of set-up is permitted by heavy concentration of magnetic flux at face plate.
4. Fine face plate mesh permits holding small pieces. (See cut.)
5. It is absolutely waterproof.
6. It is rigid and strong, face plate being supported by solid cores.
7. Coils, form wound impregnated, and insulated in accordance with best electrical practice.

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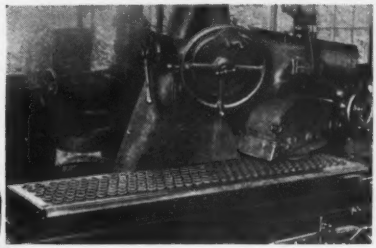
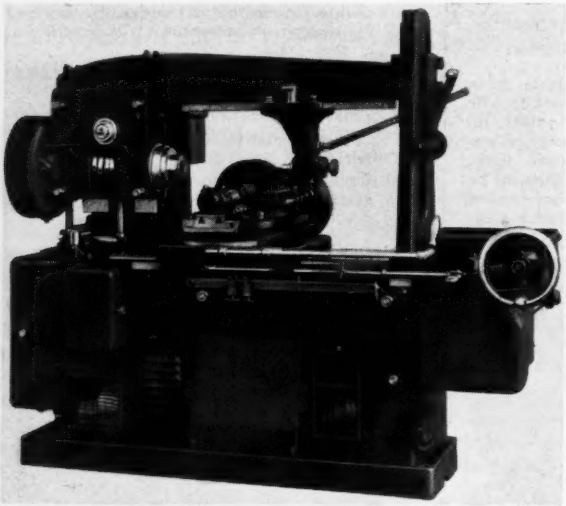


A SUPERPOWER, Size 1672, loaded with small washers for economical grinding . . . an exacting test of holding power.

New Shop Equipment

Barber-Colman "Type A" Hobbing Machine

In order to meet the demand for a gear hobbing machine with finer accuracy and greater capacity than could be obtained with the No. 12 machine made by this firm, the Barber-Colman Company, Rockford, Ill., has developed the machine shown in the illustration. This machine, which is to be known as the "Type A," is similar in design to the No. 12 machine, but has a number of distinct and valuable features. The



Barber-Colman "Type A" Hobbing Machine

Type A machine is more rugged in design and construction, has a slightly greater capacity than the No. 12, is built to deliver the maximum in accuracy, and contains in one machine the various attachments which were carried as separate units for the No. 12 machine.

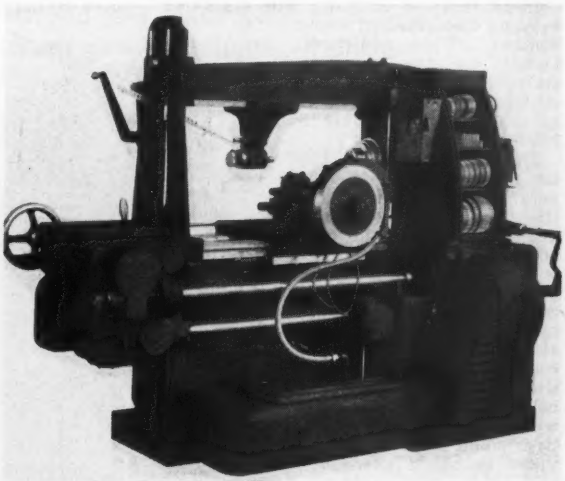
The bed and upright of the machine are of heavy ribbed box section with ample bearing surfaces for the work spindle slide and hob spindle slide. A large reservoir in the base holds the coolant, which is pumped into the cutting area and washes the chips down through channels between the bedways. The chips are caught in a perforated pan which can be removed. A one-shot oiling system insures that all bearings will be adequately lubricated.

The machine has a horizontal work spindle of forged crucible steel, accurately ground and running in double opposed bronze taper bearings, so arranged that the front and rear bearings can be readily and independently adjusted as required. Thus the correct clearances can be maintained at both ends of the spindle and all play in the work or index worm gear can be eliminated. The hole through the work spindle is 1 17/32 in. diameter, enlarged to a No. 12 B & S taper at the front to receive the work arbors, which are securely held in position by a draw-in bolt. The work spindle slide is a rigid, box-section casting, carried on tapered gibbed ways on the front of the upright. It is adjusted by means of an elevating screw with a micrometer dial graduated in thousandths.

The work arbor is supported at the outer end by an overarm bracket, or tailstock, sliding on dovetail ways and provided with a clamp handle and rapid unloading device, so that the bracket can quickly be released and moved out of the way when the work arbor load is being changed. The bracket may be fitted with a hardened and ground adjustable steel center, or with a bronze bushing to receive a hardened steel sleeve which is clamped on the work arbor. When spline shafts are being hobbed, the outer end of the shaft is supported by a special device. When desired, the work spindle may be arranged with a collet chuck mounted on

the nose to support work which cannot be mounted on an arbor.

The overarm which carries the overarm bracket is fitted and bolted securely to the top of the work spindle slide. This overarm is a box section casting and is extremely rigid. The outer end of the overarm is clamped in a slot in the overarm brace, which is fitted and securely bolted to the bed of the machine. The rapid handling device mentioned above is mounted on the overarm brace and consists of a double lever and crank mechanism with an adjustable linkage connection to the overarm bracket. By turning a handle on the front of this device, the overarm bracket is moved from or toward the work spindle nose. The lever on this linkage goes over center when the overarm bracket is pushed toward the work spindle nose, and there is a yielding connection where the linkage meets the bracket. By this means the center may quickly be pushed into the end of an arbor and held there with predetermined pressure while the bracket is being clamped. Thus loading and unloading is made easier and more rapid.



Rear view, showing louvred motor housing.

Indexing on the Type A machine is accomplished by the same means as on the No. 12; namely, a worm and worm gear mounted in a case on the work spindle slide. The worm gear is pressed onto the rear end of the work spindle. The worm is of steel, hardened and ground, and the solid, disk-type worm gear is of cast iron. A continuous bath of heavy oil is supplied to these gears from an oil reservoir in the case. The extreme accuracy with which both the worm and worm gear are finished makes the indexing mechanism thoroughly dependable. The worm is mounted in bearings in the case, where it is driven by a vertical shaft with a long keyway so that the worm may move along this shaft as the work spindle slide is adjusted up and down.

In order to provide for adjustment of the worm and worm gear to compensate for wear, the gear guard case, carrying the worm and bearings, is mounted on a horizontal slide so that it can be moved by adjusting screws. In addition, the plate which carries the bottom end of the spline shaft that drives the worm may be adjusted horizontally by means of clamp screws in slots, thus insuring that alignment of the worm in its bearings and with the worm wheel will not be disturbed.

The hob spindle is of alloy steel, hardened and ground, and is adjustable for wear. It runs in Timken tapered roller bearings, in an independent slide which is clamped to the swivel by taper gibs. Another taper gib between this slide and the swivel makes the connection between pinion and driving gear adjustable. The slide can be moved lengthwise by means of a screw with a micrometer dial to relocate the hob after it has become dull in one position.

The hob swivel slide upon which the hob slide swivel turns is made with extra long ways and is taper gibbed for wear adjustment. The swivel accommodates a range of helical settings 50 deg. either side of zero, and a vernier reading to 10 min. insures accuracy of setting. Power is transmitted from the hob drive shaft to the driving gears for the hob spindle by means of bevel gears in the bottom of the hob swivel slide. The gears are mounted in heavy duty ball bearings.

The hob swivel slide is moved longitudinally by an accurately-threaded steel

feed screw in the bed of the machine, which engages a bronze feed nut built into the slide. The feed screw is driven from the feed box at the right hand end of the machine, and can be revolved in either direction at either normal working speed or rapid traverse.

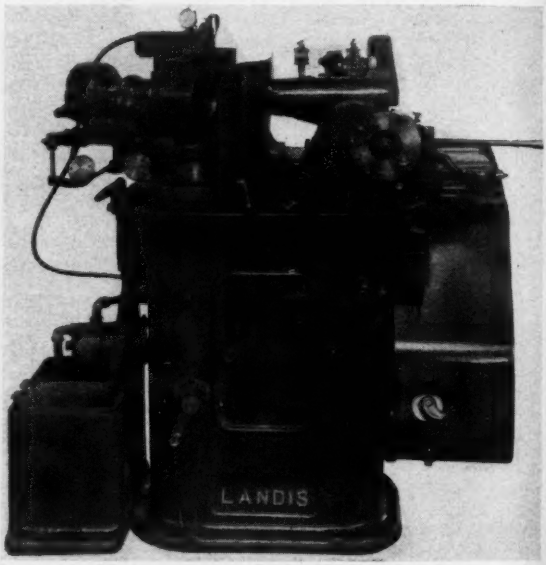
An automatic "stabilizer," consisting of two friction discs and three metal plates, is built into the bed in such manner that it provides a frictional drag or resistance to the hob swivel slide so that the hob will move steadily forward, without jump or chatter. The stabilizer may be disconnected when desired. The additional load on the machine caused by the action of the stabilizer is so slight as to be practically negligible in terms of horse-power.

The speed at which the hob swivel slide is traversed is controlled through a set of change gears, located in the feed box. The feed mechanism is interlocked with the index drive so that spiral gears as well as spur gears may be cut. The feed box also contains the constant-running drive for the rapid traverse, locking means being provided so that the working feed is inoperative when the rapid traverse is being used, and vice versa. The rapid traversing speed of the hob swivel slide is 70 in. per min.

The speed slip-gears are mounted on the front of the bed, where they are protected by a hinged cast iron guard which holds them in place. Gears are provided for eight different machine speeds. Automatic stops make it possible to set the machine for practically any series of operations. The machine is of the constant speed drive type and is driven by a 5 h.p., 1,750 r.p.m. motor, adjustably mounted in the base of the machine. A silent chain drive to the main shaft is protected by a swinging cast iron guard with concealed hinges. The capacity of the machine is approximately 12 in. diameter, and 12 in. width of face. Hob swivel slide travel, 17½ in. Capacity, D. P., cast iron, 3. Steel, 4. Max. dia. of hob, 4 in. Speed of main drive shaft, 400 r.p.m. Hob speeds, 8. Range of feed (per rev. of work), 0.015 to 0.150 in. Rapid traverse per min., 70 in. Floor space, 60 x 100 in. Net weight, 5635 pounds.

Landis 3-In. Motor-Driven Ball Race Grinder

The Landis Tool Company, Waynesboro, Penna., has brought out a ball race grinder in the design of which are included not only all the desirable features found in former Landis machines of the same type, but also several new features that make it an ideal machine for grinding ball race grooves on a high production basis. The two principal features consist in that the machine has been completely motorized and a sizing device has been added.



Landis 3-In. Motor-Driven Ball Race Grinder

The operation of the machine is practically semi-automatic. After loading the work and swinging the sizing device around to its operative position, the operator moves the wheel to the work and starts grinding. The wheel is fed in automatically from this point, being advanced twice to a predetermined setting within the space of one oscillating movement. When the raceway is almost down

Model ULO

No metal-to-metal contact

exists in the interior of GUSHER pumps to require internal lubrication. Therefore, GUSHER pumps will handle non-lubricating liquids without friction or wear and give many years of dependable service without impaired efficiency or loss of capacity.

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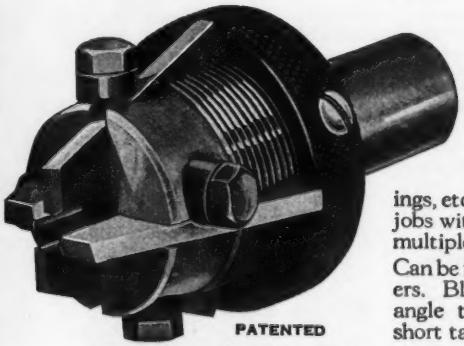

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Can be fitted with drills and reamers. Blades can be ground any angle to point work and turn short tapers.

A Genesee Adjustable Hollow Mill can be made for every job

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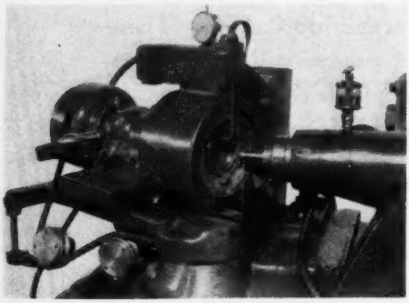
GENESEE MANUFACTURING CO., Inc.

ROCHESTER, NEW YORK

to size, the automatic wheel feed mechanism is disengaged by means of a solenoid that is controlled by the sizing device. The remaining stock is removed without further feeding-in of the wheel, and when the raceway is finished to exact size, the wheel automatically moves back a few thousandths from the work. The operator withdraws the wheel farther by giving the hand wheel an extra turn and then reloads the machine.



Work Head of Landis Ball Race Grinder in operative position.

The grinding wheel spindle is mounted in duplex-type preloaded precision ball bearings, and is driven from a jack shaft, power being delivered from a short driving drum at the rear of the machine. The grinding wheel feed can be adjusted to reduce the diameter of the work from 0.00025 in. to 0.0015 in. at the end of each half-stroke of the oscillating work head movement. The conventional Landis feed-up hand wheel is used. The grinding wheel carriage is dovetailed to the bed of the machine, and is moved to or from the work by means of a rack and pinion arrangement. The vertical oscillating spindle is fitted with a duplex-type preloaded precision bearing at the upper end and a sturdy ball bearing at the lower end. Provision is made for the prevention of backlash or shock at the ends of the stroke of oscillation. Power for the oscillating movement is obtained from a driving shaft which extends through the bed at the rear, through the medium of a worm and worm gear.

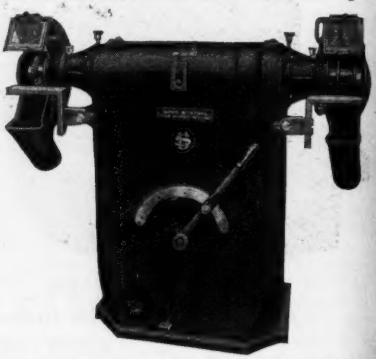
The oscillating movement of the work-carrying head is automatic, and can be adjusted for length of arc. The work head spindle is driven by a rather unique mechanism. The vertical oscillating spindle is hollow and serves both as a carrier and a bearing for a driving shaft, which extends through it. A grooved pulley at the top of the driving shaft transmits power to the left-hand end of the work spindle, by means of a round leather belt. There is also a grooved pulley on the lower end of the driving shaft, driven by a round leather belt. The work-holding chuck is not furnished as standard equipment, but the lever-operated three-finger spring-loaded type shown in the illustration is typical.

The sizing device is mounted on the work-carrying head at the rear, where it is easily swung into or out of position. A slight downward pressure at the top of the device lowers the diamond-tipped finger sufficiently for it to clear the groove. A dial indicator graduated in ten-thousandths is used, and convenient adjustments are provided to enable the operator to change the point at which the feeding-in movement stops.

The machine is driven by a 2 h.p., 1150 r.p.m. motor, mounted at the rear of the bed. A two-step driving pulley makes two work speeds and two work head oscillating speeds available. All of the drive excepting the grinding wheel rotation is disengaged by means of a lever at the front of the machine when changing work. The water pump, which is of the full-flow type, does not operate when changing work. The net weight of the machine is 2,000 pounds, and the floor space required is 31 x 56 inches.

U. S. "Model 64" Variable Speed Grinder

In response to increasing demands for a smaller model of the variable speed grinder made by the United States Electrical Tool Co., 2471 West Sixth St., Cincinnati, Ohio, this firm has brought



U. S. Model 64 Variable Speed Grinder.

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NO matter what you require in the way of gear products . . . including everything from pinion rods to internal gears . . there's an M-C Gear Product to meet your need.

And, you'll find that every M-C Gear Product is accurate enough to meet all requirements . . . accurate enough to be used on the best machine or precision instrument made.

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GAIRING
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Provide positive correction for misalignment.

Accurate work depends more upon the holder and cutting tool assembly being in perfect alignment with the fixture without deflection from the machine spindle than any other factor.

GAIRING FLOAT HOLDERS are used where the spindles of the machine are out of line with the bushing plate, where the bushing or tool holders receive excessive wear, and to correct irregularities where the spindles are indexed or where the fixture is indexed.

Write For Circular

The Gairing Tool Co.

DETROIT, MICHIGAN

Representatives in Principal Cities

out the machine shown in the illustration.

The outstanding feature of the machine is its ability to maintain a constant wheel surface speed regardless of wheel wear, using the wheels until they are worn down to the flanges. This makes for faster production and better finish with both vitrified and high speed wheels. The constant speed is obtained by means of the patented Gibbs V-disc transmission of graphitized micarta which is incorporated in the mechanism of the machine. As the wheel wears, the operator shifts easily and almost instantly from one spindle speed to the next by means of the hand lever and foot pedal shown on the front of the machine in the illustration. The speed lever is interlocked with the wheel guards, making excessive speeds impossible.

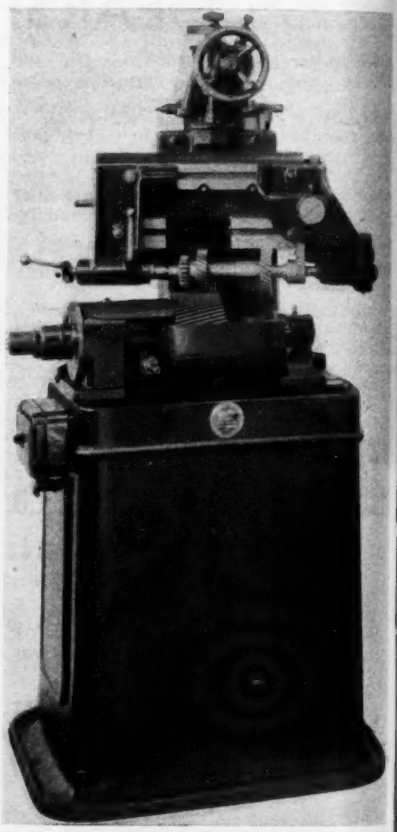
Operating on alternating current, it is said that this transmission shows the highest efficiency under long, heavy loads. It is positive in action, will not slip, and is free from backlash. It is also durable, easily accessible, and low in replacement cost.

The grinder is built for continuous, heavy duty service, and to N. E. M. A. standards, with a temperature rise of 40 deg. Ball bearings are used throughout in dust-proof housings. The motor shaft and wheel spindle are of chrome manganese steel and the adjustable wheel guards are of cast steel. A conveniently-located push button and no-voltage release are features of the control. The grinder is regularly supplied in sizes to accommodate wheels 12 x 2, 14 x 3 and 18 x 2 in. for 220, 440, or 550 volts, 25, 30, 40, 50, and 60 cycles, 2 or 3-phase alternating current.

Model GLF "Red Ring" Gear Tooth Lapping Machine

The Model GLF "Red Ring" Gear Tooth Lapping Machine, made by the National Broach & Machine Co., Shoemaker and St. Jean Sts., Detroit, Michigan, is said to involve a new method of finishing gears by the lapping process. The machine will lap transmission gears up to 7 in. diameter, and is used chiefly in the lapping of spiral gears, as shown in the illustration. The machine is so designed that the axes of the lap and gear are not parallel, but are set at the correct angle to produce the correct angle of spiral on the gear teeth. It is said that this method of lapping will correct the tooth curvature and any index error, and will also eliminate any eccentricity.

The gear is reciprocated, in operation, so that the lapping action is spread across the face of the gear, producing the same finish at all points on the gear.



Model GLF "Red Ring" Gear Tooth Lapping Machine.

A reversing switch provides for lapping both sides of the teeth. An adjustable oil brake in the tailstock provides for the application of a uniform load, and the pressure can be increased to provide a "brake" load on the gears while lapping in cases where such a load is required.

The maximum capacity of the Model GLF machine is 7 in. diameter, 5 D.P.

No Time Wasted Changing Speeds!

HERE is the New High Speed VICTOR SUPER-DRILL equipped with ball and thrust bearings throughout, also with the "Wonder Pulley"... an exclusive, patented feature which gives you five spindle speed changes *without touching a belt or stopping the machine.*

This feature alone pays for the VICTOR SUPER-DRILL in a very short time. It makes *versatility* the key-note of this drill. There are no belts to change... no time lost. The different types of drilling it can do are unlimited. Let us show you... write for an illustrated circular.

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They grind formed holes as well as straight—and any size from .050" up.

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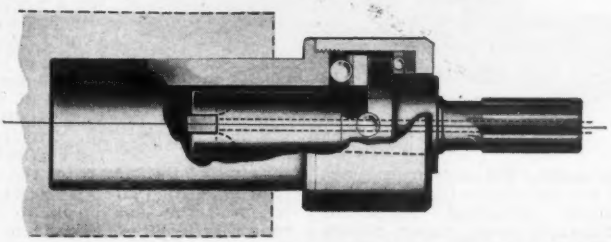


FLOATING TOOL HOLDER

For use on hand and automatic screw machines. This holder compensates for mis-alignment of machine and will ream and tap holes true to size. Overhang is very small as the Morse Taper is inserted into shank of holder. Float is accomplished by means of ball bearings. Five sizes to take up to No. 5 Morse Taper.

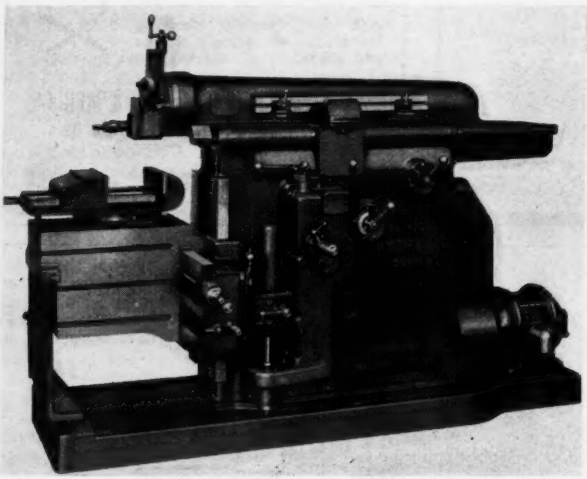
WRITE FOR FULL INFORMATION

THE APEX MACHINE & TOOL COMPANY
300 DAVIS AVENUE **DAYTON, OHIO**

1½ in. width of face, and 12 in. between centers. The model GLE machine, which is of the same design excepting that it is larger, will take gears up to 15 in. diameter, 4 D.P., 5 in. width of face, with 18 in. between centers. The normal time for lapping a transmission gear is from 3 to 5 minutes. One operator can run from 3 to 4 machines. The machine is furnished with built-in motor drive, reversing switches, and automatic feed.

Rockford Hy-Draulic Shaper

A shaper that is designed to employ hydraulic power both for ram drive and for feeds has been brought out by the Rockford Machine Tool Co., 2414 Kishwaukee St., Rockford, Ill. The machine



Rockford Hy-Draulic Shaper.

is of exceptionally rigid design and has a number of advantageous features, such as an almost unlimited range of instantly-adjustable feeds, higher return speeds than have ever before been available in commercial shapers, centralized controls and simplified adjustments, power rapid traverse both vertically and horizontally, and the smooth, positive action that is available only through the use of hydraulic power.

The machine is entirely self-contained, the entire machine, including the motor, being mounted on a heavy base. The ram is set into the column in bearings that are 42½ in. long and 12½ in. wide. The length of the ram is 56 in. The length of the stroke can be varied from 1 in. to 25 in., and speeds can be obtained up to 150 strokes per min., providing cutting speeds of from 0 to 120 ft. per min. The speed of the ram remains constant throughout the length of the stroke, and is independent of the length of the stroke. The length of the stroke and its position relative to the work are governed by two dogs, mounted in a T-slot on the ram, which can be adjusted quickly and safely by hand—while in motion, if desired.

In the Hy-Draulic Shaper the number of feeds is absolutely unlimited up to 0.160 in. per stroke. Any amount of feed desired can be obtained instantly. The feed-control resembles the barrel and thimble of a micrometer; the barrel is graduated in the same manner, and the thimble is as easy to set for the feed desired. If the feed is changed while the machine is in operation, the change actually takes place as the tool clears the work at the end of the succeeding return stroke, and is practically instantaneous. A ball handle enables the operator to instantly reverse the direction of ram travel at any point desired, even when taking a heavy cut.

The top of the table is 16 x 24 in. and the height is 17¾ in. The table has a horizontal travel of 30 in. and a vertical travel of 14 in. The head can be fed vertically 7 in. The maximum distance from the table to the ram is 18 in. The vise jaws are 3 x 14 in., and the vise opens to 15 in. The motor is 10 h. p., 1800 r.p.m. The floor space required is 4 ft. x 8 ft. 3 in., and the weight of the machine is 6200 pounds.

Hammond "Rite Speed" Polishing Lathe With Independent Overhanging Spindles

The illustration shows the latest addition to the line of "Rite Speed" polishing and buffing lathes made by Hammond Machinery Builders, Kalamazoo.

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INGOTS, SOLID BARS, CORED BARS CASTINGS FINISHED TO SPECIFICATIONS
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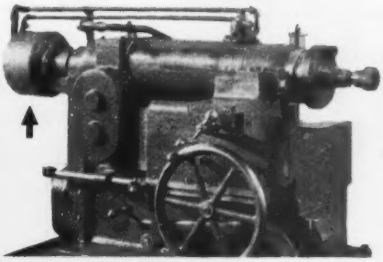


. . . . . for Quick Action!

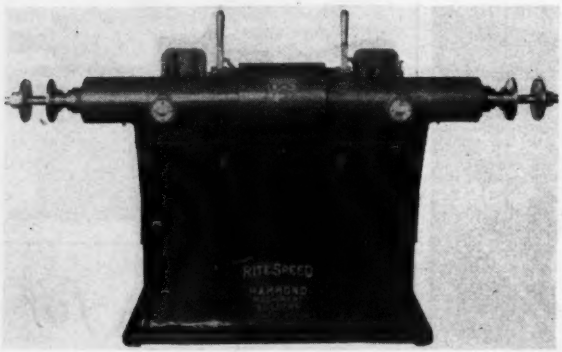
WHEN it comes to chucking, or holding work in all types of machines . . . **quick action** is the factor which eliminates waste in time, effort and motion.

And, **quick action** is what you get with LOGAN Devices on the job. A single movement of the control valve is all that is necessary to operate drill jigs, vises, arbor presses, milling fixtures, etc. The illustration shows a LOGAN installation for operating a work holding fixture on a special machine. Its **quick action** speeds up production.

LOGAN **quick action** will eliminate waste in time, effort and motion in your shop more effectively than any other method. Let us show you. Write for Catalog S-25.

The Logansport Machine Co.
LOGANSPORT INDIANA

Michigan. The machine is the Type CCO Polishing Lathe, which is similar in design to the other machines of this line with the exception that it is equipped with independent overhanging spindles,



Hammond Type CCO "Rite Speed" Polishing Lathe With Independent Overhanging Spindles

thus providing a maximum of working clearance. The overhang of the spindles is 8 in., from the center of the spindle to the front of the pedestal.

Each spindle has its own motor, starter, multi-V belt, switch, and brake. Each spindle can be operated independently of the other, which is a distinct advantage where wheel changes are frequent or where the operation requires two different speeds. The spindles can be operated at any speed desired. Belt tension adjustment on this machine is obtained through a screw feed slide rail on the rear of the pedestal. The machine is designed for use with either two 3, two 5, two 7½, or two 10 h.p. motors.

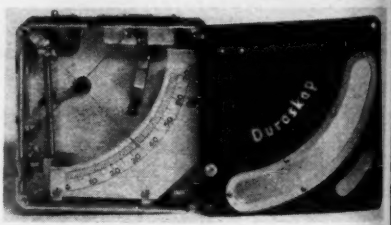
The machine can be supplied equipped with the Hammond standard oiling system or with Cascade oiling system, which consists of an oil pump that is driven by a worm and worm gear, the worm being cut on the spindle. The oil is forced from the oil pump through a Purolator filter, from which it passes continuously to a larger reservoir. This oiling system assures that clean oil will be fed to the bearings constantly under pressure. A glass front oil-level gauge and pressure indicator are standard equipment with this system.

"Duroskop" Portable Hardness Tester

A hardness testing instrument which has the advantage that it can be taken to the work has been placed on the market by The R. Y. Ferner Company, 1129 Investment Bldg., Washington, D. C. The design of the instrument, which is called the "Duroskop," is based upon the principle of a falling pendulum, and is such that tests can be made rapidly and accurately.

In use, the Duroskop is held against the piece to be tested and a button on the back of the case is pressed, releasing a pendulum which falls through a hole in the edge of the case, striking the workpiece. The pendulum rebounds to a height that is determined by the hardness of the workpiece, carrying with it a pointer which remains at the highest point on the scale to which the pendulum rises. Thus the operator will have no difficulty in determining the exact point to which the pendulum rebounded.

The pointer, which is pivoted at the center of the arc of the scale, is lightly prevented from shifting by means of a wire that is stretched across the pointer in such manner that it presses down on the pointer slightly and causes it to rest also against the edge of the scale over which it moves. After a reading has been taken, the pendulum is readily restored to its upper position by the turning of



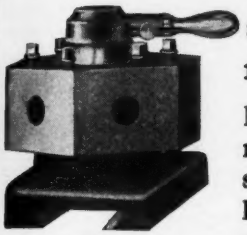
"Duroskop" Portable Hardness Tester.

a spring-actuated lever. A leaf spring engages and holds the pendulum ready for the next test.

In being raised to the upper position, the pendulum picks up and carries along the pointer to the upper end of the scale. The section of the scale just beyond the 70-degree mark is bent upward, however, so that when the pointer reaches this inclined surface, it is raised out of engagement with the pendulum and can quickly be brought back to the zero po-

STANDARDIZED

LATHE TURRETS



STYLE "0"
Hexagon head, for round shank tools and bolted on fixtures.

8 Styles
12 Sizes

For any make or size of Lathe, old or new.

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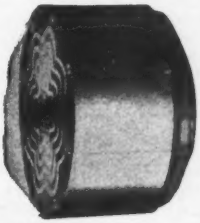

STANDARDIZATION pays, particularly when the tool is as far ahead of its class as the D & W chuck. Oil and waterproof, it is designed and constructed to give maximum holding surface with exceptionally strong and uniform pull throughout. Cables are protected by rubber tubing — special demagnetizing switches for readily releasing the work.

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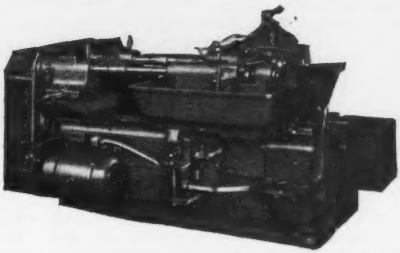
ONE of our special machines is shown at left. Others are illustrated and described in our booklet entitled "Performance"—write today for a copy. Send drawings and production data for reliable estimates.



Barnes semi-automatic machine for very accurate and rapid boring with diamond tools.

W. F. and John Barnes Co.
ROCKFORD, ILLINOIS
Established 1872

sition by a lever on the front of the instrument case. Crossed V-grooves in the face of the instrument that is placed against the workpiece provide for setting it properly against cylindrical pieces in either horizontal or vertical position. The instrument is, in fact, especially useful for checking case-hardened rollers. A built-in level on top of the case facilitates adjustment.

Practically no mark is left in the surface of parts under test; a hand glass is usually required to detect the point at which the blow was struck. Material as thin as 0.002 in. thick can be successfully tested with this instrument.

The instrument is complete in itself, with no attachments to be added. It weighs less than 13 ounces and is 4⅛ in. square by 1¼ in. thick—small enough to be slipped into a pocket. It is supplied in a polished wood case.

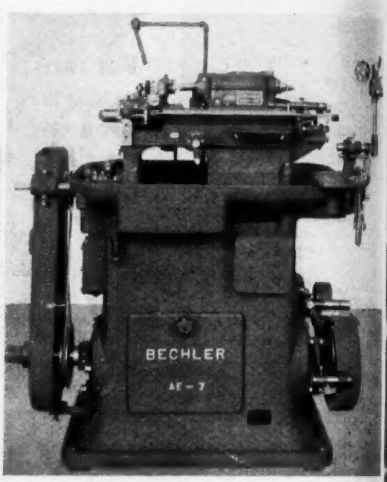
Bechler Universal Automatic Screw Machine

A high precision automatic screw machine made by the Andre Bechler Co., Switzerland, has been placed on the market through this company's American agents, the Triplex Machine Tool Corporation, 50 Church Street, New York, N. Y. The machine is particularly adaptable for the production of small and medium size parts where high accuracy is required, as in the manufacture of instruments, clocks, electric machinery, and so on, and the design of the machine makes possible the production of long pieces and pieces of complicated design that are difficult to produce on other types of machines without second operations.

On the Bechler machine, none of the four tools travel longitudinally, the bar stock being carried past the tools by the headstock, which advances and recedes intermittently along a slide while the tools feed alternately in and out of the work. The combined movements of the headstock and tools make possible the production of a wide variety of work. When the headstock spindle collet opens, the bar is pushed through a fixed bushing in the front of the headstock, where it is supported during the operation.

The two horizontal tools are fixed on a swiveling carrier that is operated by a cam in such manner that the tools feed into and out of the work alternately. The front tool usually does the turning, while the rear tool is used for cutting off. The other two tools are fixed vertically on a special frame, and these tools are usually used for turning, knurling, recessing, and so on. The vertical tools do not show in the illustration.

An outstanding feature of the machine is its remarkable precision, which, by means of double micrometer adjustment to all tools, makes it possible to produce

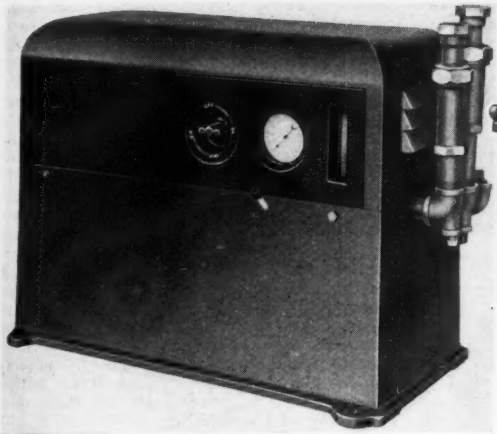


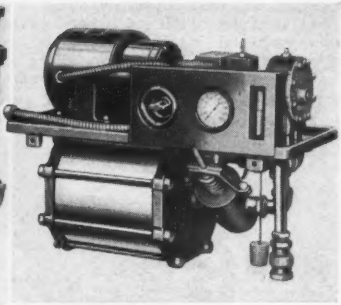
Bechler Model AE-7 Universal Automatic Screw Machine

work with a fine finish to an accuracy of 0.00025 in. on both diameter and length. More than thirty different attachments are available for standard and deep-hole drilling, short and long threading and tapping, forming, slotting, taper-turning, internal recessing, and so on. The machine is made in three sizes—⅛ in., ¼ in., and ⅜ in. bar capacity x 2¾ in. length—and all attachments and cams are interchangeable on all three sizes. The best speed for any job can be obtained, as there are 88 different camshaft speeds on the motor-driven models.

"Logan" Hydraulic Chuck Equipment

The Logansport Machine Co., Logansport, Ind., has developed a hydraulic power unit especially designed for operating chucks, work-holding fixtures, clamps, hoists, and so on, in connection with any type of machine shop equip-





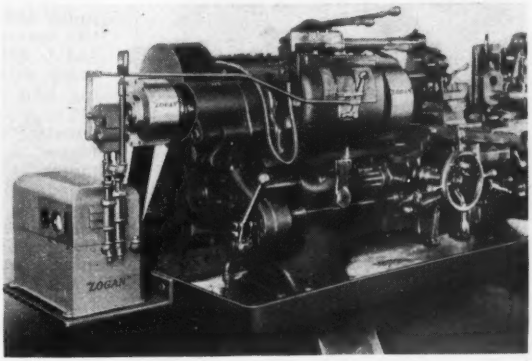
(Left)—Logan Hydraulic Power Unit. (Above)—A disassembled view of the unit, showing the accumulator, pressure regulator, motor, pump, and switches.

ment on which such devices are used. The unit is of the accumulator, constant-delivery, variable-pressure type, with pressure available of from 50 lb. to 200 lb., adjustable through a regulating valve.

The accumulator is of the spring type and acts as a pressure reserve for the unit. Accumulator pressure is from 225 to 275 lb., and is always above the maximum taken out through the regulating valve. When a pressure of 275 lb. is built up in the accumulator, the motor is automatically cut out, and when the pressure drops to 225 lb., the motor is automatically cut in again until the pressure has been built up to 275 lb. This method of pressure control eliminates the by-passing of oil, with consequent loss of efficiency.

The illustrations show the unit assembled and disassembled, and as mounted on a Warner & Swasey turret lathe. The equipment shown in the latter illustration consists of a Logan 15-in. three-jaw universal steel body chuck, 8-in. model with "HV" cylinder, and the power unit illustrated above. A panel board is also provided, carrying the "On" and "Off" motor switch, pressure gage, and oil level gage. The hydraulic control valve is an integral part of the cylinder, which reduces the piping required from the power unit to the cylinder to the minimum.

The operating time of the equipment is 1½ seconds. Constant pressure is applied to the work, maintaining full gripping pressure during the machining operation.

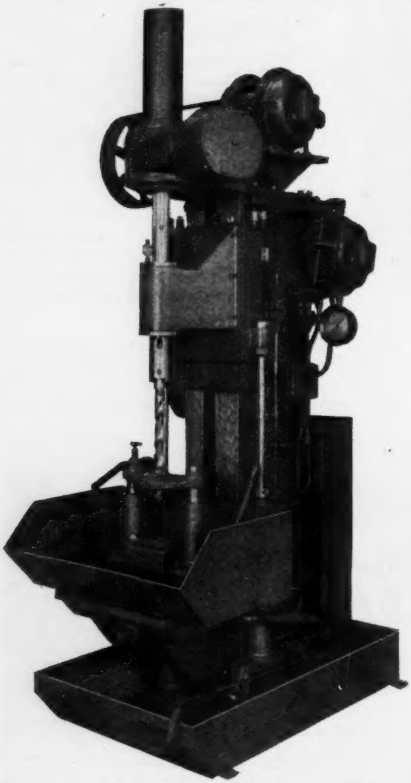


Logan Hydraulic Power Unit mounted on a Turret Lathe to operate a three-jaw universal chuck.

Baker No. 4-VH Oilfeed Drilling and Boring Machine

The latest addition to the Baker line of hydraulic feed machines is the No. 4-VH Oilfeed Drilling and Boring Machine, shown in the illustration. In the

design of this machine the hydraulic feed feature, with its many advantages, is combined with extreme ruggedness, flexibility and simplicity. The machine as designed is adapted for either single spindle drilling or boring, as shown in



Baker No. 4-VH Oilfeed Drilling and Boring Machine.

the illustration, or for use in connection with an indexing table for successive operations on the same piece. The particular set-up shown in the illustration is for drilling an automobile cluster gear 1 17/32 in. wide and 1½ in. long.

The saddle that carries the head mounting is of generous proportions, sliding on carefully-scraped ways, and actuated by the Baker "Twin Pull" construction, which consists of a cylinder mounted on each side and working in unison.

The simplicity of design is evident in the spindle drive. The drive is from a motor with multiple "V" belts to a drive bracket carrying four alloy steel gears. Two of these gears are slip change spur gears which can be readily changed to provide different speeds, and the others are spiral bevels. The shafts are mounted on ball bearings of ample size, and provision is made for the automatic lubrication of these parts while the machine is in operation. The speed changes available from the combination of gears that can be furnished range from a minimum of 46 r.p.m., which represents a 60-ft. cutting speed on a 5-in. diameter, to 836 r.p.m., which represents a cutting speed of 70 ft. on a $\frac{1}{16}$-in. diameter. The motor recommended depends upon the work to be done. The machine has ample capacity to transmit up to 10 h.p. on the spindle drive, which means that in practically all cases the capacity of the machine is limited by the cutting tools.

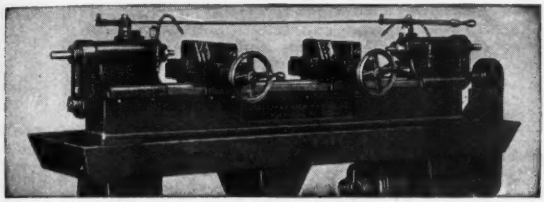
The spindle is multiple-splined at the top where the spiral bevel gear fits. The spindle runs on preloaded ball bearings having thrust capacity of 10,000 pounds. In addition to this, a large radial thrust ball bearing is used in the upper bearing in the head housing. For the single spindle machine, the spindle end is fitted with standard No. 5 Morse taper with a drive slot for driving boring and facing cutters, and so on.

The feed is actuated by a constant-delivery pump mounted in the main frame and driven by an independent motor, an ample oil pump being provided in the frame of the machine. The cycle of the operation is entirely automatic. By stepping on the foot treadle the operator opens the control valve and starts the spindle moving downward at a rate of 120 ft. per min. It trips into feed at a predetermined point, drills to the required depth, and then automatically returns to the upper position. The rate of feed can be changed instantly if desired.

The machine can be furnished with standard plain table with vertical adjustment, as shown, or with box-type table fitted with an indexing table for multiple operations. The chip pans are of ample size. A lubricant sump is provided in the base of the machine.

B. & S. Cutter Adapters

The Brown & Sharpe Manufacturing Co., Providence, R. I., has brought out a line of cutter adapters for use with milling machines having standardized spindle



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Double End Centering Machine

For centering both ends of a shaft simultaneously. Spindles operate together or independently. L. H. head is removable for long shafts. Accommodates a wide variety of work. Special fixtures furnished when desired. Send for Bulletin.

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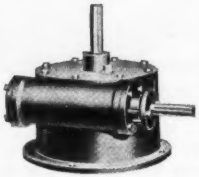

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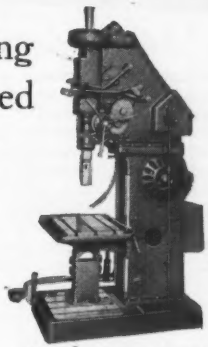

No. 242—Capacity 2", swing 24".

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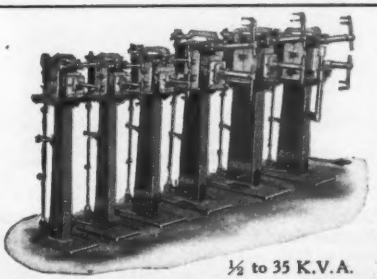
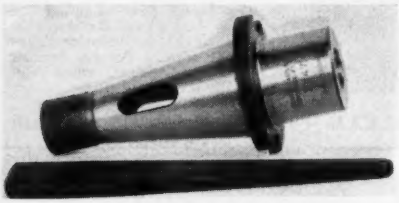


½ to 35 K.V.A.

ends with No. 40 taper, to accommodate end mills, collets and other tools having No. 3 Morse taper and No. 7 and 9 Brown & Sharpe taper shanks.

While there are, at the present time, few milling machines with No. 40 standard taper ends, these adapters anticipate present plans of machine tool manufacturers to incorporate this taper in machines of the smaller sizes.

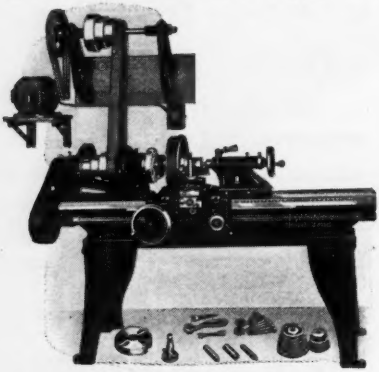


Brown & Sharpe Cutter Adapter

The adapters will find a wide range of usefulness, particularly among manufacturers who may have milling machines with the standardized spindle end, who may wish to use end mills, collets, and other tools having the Brown & Sharpe and Morse tapers mentioned above.

South Bend 16-In. Lathe

A general-purpose lathe, especially designed for light manufacturing, for general machine shop use and for maintenance work, has been added to its "Junior" line by the South Bend Lathe Works, South Bend, Indiana. The lathe has a 16-in. swing, which permits the handling of large-diameter work, and is available in lengths of from 6 ft. to 12 ft., making possible the handling of work of unusual length. The design and construction of the lathe has been simplified and it has been relieved of non-essential, expensive features not needed in the class of work for which the lathe is intended.



South Bend 16-In. Lathe

The lathe is of the back-geared, screw-cutting type, with automatic longitudinal feed and eight changes of spindle speeds. All standard screw threads may be cut, from 2 to 40 per in., right or left hand, including 11½ P. pipe thread. The headstock spindle is of special carbon steel, ground, with a 1⅝ in. hole through its entire length.

Bearings are of phosphor bronze and are adjustable for wear. The tailstock has a graduated spindle, hardened center, and improved binding plugs, and may be set over for taper turning. The compound rest will swivel to any angle, and has an angular travel of 3¾ inches.

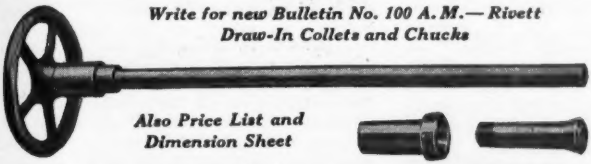
The lathe can be furnished with countershaft drive or in various types of motor drive to fit the needs of any shop. A full description of the lathe is given in Catalog No. 92, which can be had upon application.

New Developments on Keller Automatic Tool Room Machines

The Keller Mechanical Engineering Corporation, 84 Front Street, Brooklyn, N. Y., announces that the "right and left attachment," which has in the past been built for the smaller model of Keller Automatic Tool Room Machine, is now available for work of all sizes, including large stamping dies.

For instance, with this attachment it is now possible to produce, from a wood pattern of a right side panel, both the right and left panel punches, whereas in the past it was necessary to have a pattern of each panel. The advantages are obvious, especially in view of the difficulty of making right and left patterns that are exact counterparts.

For ordinary duplication work, the model and workpiece are stationary on the machine fixture; to produce a reverse of the model, the "right and left" fixture introduces a relative horizontal movement between the model and workpiece. The workpiece still remains stationary, but the movement of the model in connection with the movement of the cutter has the same effect as though the model were traveling in the opposite direction



Write for new Bulletin No. 100 A. M.— Rivett Draw-In Collets and Chucks

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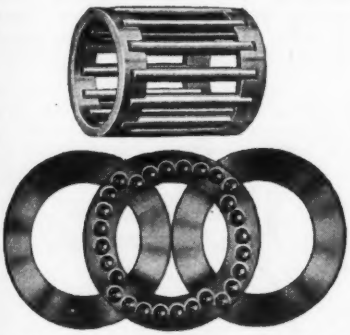

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Anderson Improved
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No Leveling Required

A simple and excellent device for balancing, straightening and trueing.

They are made in the following sizes:

Swing	Greatest Distance Between Standards	Capacity in Lbs.
20 in.	20 in.	1,000
40 in.	30 in.	2,000
60 in.	30 in.	2,000
72 in.	66 in.	5,000
96 in.	88 in.	10,000

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1926 Kishwaukee Street, Rockford, Ill.

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WITH A
Simplex-M Abrasive Band Grinder

This Grinder accelerates production and cuts costs. Hand emerying or filing operations are antiquated in comparison. The use of this new modern machine assures straight grain finishes with sharp edges.
Details of this and other styles and sizes on request.

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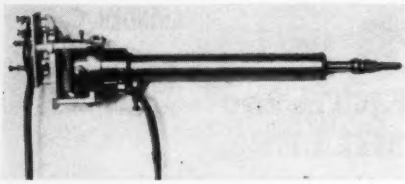
from the workpiece, so producing a "left" from a "right" or vice versa.

Another development is a device known as a "combination tracer," in which are combined the features of the

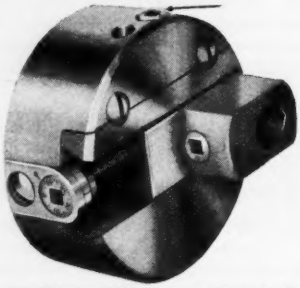


Keller "Combination Tracer"

two electrical tracers used on Keller machines. The combination tracer makes it possible to follow all three dimensions of a model at the same time. It is, for instance, possible to cut a bead in a drawing die punch, the tracer point traveling along the edge of the bead and at the same time following any variation in depth of the model. Besides a great saving in time over the method now employed on Keller machines, the new method produces a perfectly smooth finish and eliminates practically all hand finishing work on these operations.

No. 30 Flynn Micrometer Boring Head

A Flynn Offset Micrometer Boring Head of a much larger size than has been available heretofore, to be known as the No. 30 size, has been placed on the market by J. M. Waterston, 427 Woodward Avenue, Detroit, Michigan. The head is of the dovetail design, and is



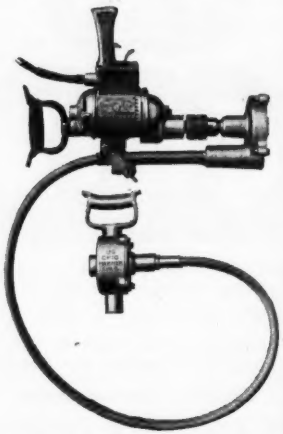
No. 30 Flynn Micrometer Boring Head

particularly adapted for use where a large amount of offset is required.

The body of the tool is of solid steel, with a dovetailed, hardened tool holder having an offset of 2½ inches. It is equipped with a tension gib and locking device to take the strain off the micrometer screw. The dial is graduated in thousandths of an inch, with 0.050 in. to a turn. The diameter of the body is 4½ in. and the length is 1¾ in. The head will take bars of from ¼ in. to ¾ in. diameter.

U. S. Electric Hammer

An electric hammer that weighs only nine pounds has been placed on the market by The United States Electrical Tool Co., 2471 West Sixth Street, Cincinnati, Ohio. It is stated that the hammer will strike 4,000 blows per minute up to



"U. S." Electric Hammer

one inch. The light weight of the hammer is made possible by operating the tool through a special flexible shaft attachment, connected with any light type of half-inch electric drill.

In addition to a large decrease in weight for a hammer of this capacity, it is claimed that the flexible shaft also prolongs the life of the tool by absorbing the destructive jarring otherwise imposed on the power unit. The hammer member is of the finest Swedish steel, and high grade ball and roller bearings are used throughout. Ease of handling is a feature of the tool.

Improvements in Binghamton Portable Electric Grinder

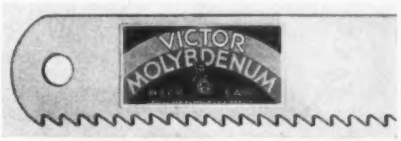
The Binghamton Portable Electric Grinder, made by the Binghamton Flexible Shaft Co., Maple Avenue, Johnson City, N. Y., has been redesigned to include a number of features of particular advantage to industrial plants. The single and three-speed machines are now equipped with a tilting and swiveling fork for the motor unit, as shown in the illustration. Thus the source of driving power automatically aligns itself with the flexible shaft, regardless of the position in which it is being used, and adds to the life and service of the shaft.

Grooved pulleys and V-belts are now used on all machines equipped with the four-speed drive. Rubber casings of sturdy design are standard equipment. The motor is of the full ball-bearing type, and is totally enclosed. The hand piece and countershaft are also of the ball-bearing type. The machine is completely described in Circular No. 50, issued by this company.

"Binghamton" Portable Electric Grinder

Victor Molybdenum Heavy Duty "Extra Value" Hack Saw Blade

Victor Saw Works, Middletown, N. Y., has brought out a heavy duty hack saw blade, for hand and power use, which is to be known as the Victor Molybdenum Heavy Duty Hack Saw. This blade is said to be the result of research and experimentation extending over a period of several years, during which practically every known metal and combination of heat treatments was tried out in an effort to produce a blade that would give the desired results at a nominal cost.



Victor Molybdenum H. D. "Extra Value" Hack Saw Blade.

The success that has crowned the efforts of the research engineers is based upon the use of Molybdenum, which has many of the characteristics of Tungsten but is much less expensive. The use of Molybdenum as an alloy makes the metal in which it is used highly resistant to shock and wear, which is a desirable quality in a hack saw blade. The blade is gold-colored for ease in identification.

Howe Jak-Tung Truck

An improved Jak-Tung Truck for industrial use has been announced by Howe Chain Co., Muskegon, Michigan. This truck uses as its basic principle the design of the tote truck that has been marketed by this firm for many years. The Howe Jak-Tung Truck is a simply designed unit, well adapted for use as a hand truck or trailer, and for the temporary storage of materials. A body of hardwood or steel, suitably shaped for the product to be handled, is permanently attached to two rear wheels, with a malleable iron leg supporting the front. This represents the storage unit; immovable, self-contained, occupying but little more space than the materials carried.

For use as a hand truck, the jack tongue is inserted in the draw bar, as illustrated, and a simple downward movement of the handle exerts a cam action,

elevating the front leg 1¼ in. from the floor and transferring the load to the jack tongue wheel. The truck can then be pulled over rough floors, door sills, or soft foundry floors with a minimum of effort. The improved roller bearing wheels make the moving of a truck, or a train of trucks, a simple matter. To couple the trucks in a tractor train, the truck is brought into position, the jack tongue removed, and a trailer hitch inserted in its place and coupled to the

Howe Jak-Tung Truck

clevis of the preceding truck. The three-wheel construction insures accurate tracking and permits short turns. Tractor trains of 33 trucks are said to have been found practical. The permanently-attached rear wheels and the handle cast integral with the draw bar permit the ready movement of empty trucks without the use of the jack tongue. The inexpensive jack tongues may be had in such quantities that they are readily accessible, rendering it unnecessary to waste time looking for the usual transportation unit.

The truck body is of ⅛-in. steel, welded to a steel platform. The wheels are of malleable iron, all wheels being interchangeable on a ⅞-in. case hardened steel shaft. The wheels run on roller bearings with Alemite fittings. Tight grease seals and hardened thrust washers are provided between the wheels and the frame.

Reeves Variable Speed Transmission Catalog No. 99

Catalog No. 99, containing complete information as to the design, construction, operation, uses, and range of sizes and possibilities of the Reeves Variable Speed Transmission has been released by the Reeves Pulley Company, Columbus, Indiana. The transmission made by this company is a compact and self-contained mechanical unit, of comparatively simple construction, and designed, as its name implies, to provide infinitely adjustable speed regulation for any type of production machine. The speed regulation obtained through the use of the unit is infinite between predetermined high and low limits and the closest graduation of speed control, even to the smallest fraction of a revolution per minute, is available. The speed changes are made smoothly and without jerks or steps in speed. Speed changes can be made without stopping the machine.

The book contains a great number of illustrations of the transmission in operation with various kinds and types of mechanisms, with complete descriptive matter. A list of the industries in which the transmission is used is also included, enumerating the different mechanical units to which the transmission has successfully been applied. A table of sizes, classes and speed ranges, together with complete dimension diagrams for the various applications, will give the reader all the information he needs.

Carpenter Booklet on Steel Testing and Tempering

Every person who is interested in the hardening and tempering of tool steels will be interested in the book, "Tough Carbon Tool Steel," which has been issued by The Carpenter Steel Company, 123 West Bern Street, Reading, Penna. The book explains what is meant by "timbre" in tool steels and explains the difference between the "hot acid etch" method of testing steels and the "timbre" test. It also tells why brittle timbre steels are more likely to crack in the hardening, and how timbre affects grinding checks.

A number of illustrations are included, showing sections of steel in the various stages of heat treatment and testing. The book is printed on a heavy enameled stock, so that every possible detail of the illustrations can be seen. Examples are shown of steels of different timbres after they have been subjected to an identical treatment. Pictures of the actual pieces are reproduced, showing the types and locations of cracks, and photomicrographs are shown so that the reader may see the difference in the grain of the steel.

A copy of the book can be had by addressing the Carpenter Steel Company at the above address.

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A Complete Welding Course

Oxy-Acetylene Welding and Cutting. By Stuart Plumley, Chief Engineer, Smith Welding Equipment Corporation, Minneapolis, Minn. 410 pages, 7¾ x 11 in. Clothboard covers. Published by Stuart Plumley Course of Instruction, 2627 Fourth Street, S. E., Minneapolis, Minn. Price, $5.00.

Some twenty-two years of experience in active connection with the oxy-acetylene welding industry, during which time the author studied every angle and phase of welding by the oxy-acetylene method, has been condensed to form the text matter of this volume. The purpose of the book is to provide a course of instruction which will enable students and others who wish to learn welding to begin with the simplest and most elementary work and progressively study and practice the process until they are skilled in the art of welding and cutting.

The text is so arranged that accompanying each lesson is a job sheet, describing the specific work which the student is expected to do as practice work with the torch. The lessons begin with a discussion of the gases, oxygen and acetylene, and the welding and cutting apparatus. As the student progresses, he is led into work of a more complicated nature and is made familiar with the methods involved in the welding of practically every type of job. The book contains 568 illustrations.

"Rego" Welding Equipment Catalog No. 57

Many helpful hints for the welder are included in Catalog No. 57, which has been issued by The Bastian-Blessing Co., 242 East Ontario Street, Chicago, Ill. This Company manufactures "Rego" welding and cutting equipment.

Rego Catalog No. 57 is a pocket-size booklet of 40 pages, indexed for ready reference. It lists specifications and prices of all types of welding and cutting torches, regulators, gas economizers, acetylene generators, and the various accessories. It also describes each piece of equipment and lists its uses. The chapters on "How to Make Up a Special Outfit," "How to Choose a Torch," and "Regulators Make the Outfit" are of especial interest and value to those concerned with gas welding or cutting.

Copies of the catalog will be sent without charge, upon request.

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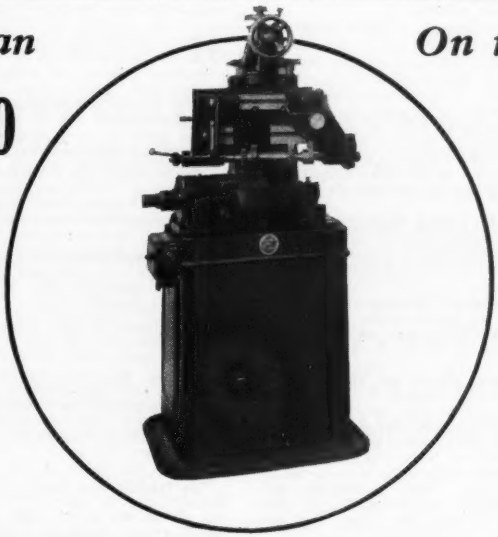

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Gear Tooth Lapper

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Ames Gages: Catalog No. 50, issued by the B. C. Ames Company, Waltham, Mass., contains complete descriptions and illustrations of the dial gages, gage heads, upright gages, cylinder gages, dial micrometers, and precision verifiers, special gages and attachments made by this company. Copy free upon request.

Scraping By Power: Bearing surfaces can now be scraped with a power scraper that is quicker and easier than the old-fashioned hand method. The tool is described in a folder that is issued by Anderson Bros. Mfg. Co., 1926 Kishwaukee St., Rockford, Ill. Sent free on request.

Steel Furniture for the Shop: The complete line of steel furniture made by the Angle Steel Stool Co., Plainwell, Michigan, including steel stools and chairs, steel foremen's desks, lockers, tables, tool stands, machine tenders, shop boxes and pans, iron bar racks, trucks, bench legs, and bench drawers, is described and illustrated in Catalog "C," which is issued free to machine shop executives.

Stop Tap Breakage: A booklet that tells how to stop the breakage of taps, reamers, and other tools, by the use of a friction chuck, also how to use the chuck for setting studs or nuts, has been issued by The Apex Machine & Tool Co., 200 Davis Avenue, Dayton, Ohio. Sent free upon request.

Machine Shop Accessories: Catalog B-27, issued by the Armstrong Bros. Tool Co., 328 N. Francisco Ave., Chicago, Ill., describes the line of tool holders, boring tools, wrenches, pipe tools, ratchet drills, lathe dogs, and other tools manufactured by this company.

Hold Odd-Shaped Pieces Securely: A vise in which odd-shaped work can be held securely without the need of special jaws or fixtures is described in a folder that has been issued by The Avey Drilling Machine Co., P. O. Box 487, Cincinnati, Ohio. Copy free upon request.

Hobs and Milling Cutters: A complete line of milling cutters and hobs for cutting all kinds of gears, splines, sprockets and other forms is described in Catalog G, issued by the Barber-Colman Company, Rockford, Ill. Descriptions and illustrations of the Barber-Colman hobbing machine and hob-sharpening machines are included. Sent free on request.

All-Geared Drilling and Tapping Machines: A catalog describing in detail the various types of all-geared, self-oiling, drilling and tapping machines made by the Barnes Drill Co., 801-851 Chestnut Street, Rockford, Ill., will be sent free upon request.

Modern Drilling Equipment: Circulars describing the various types and sizes of Barnes upright drills, multiple drills and horizontal drilling machines made by this company have been issued by the W. F. & John Barnes Co., Rockford, Ill.

Groenerd Arbor Presses: Catalog No. 36, issued by the Edwin E. Bartlett Co., Nashua, N. H., describes and illustrates all the various types and sizes of arbor presses made by this firm. Copy free upon request.

Automatic Oiled Die Sets: The automatic oiled die sets, die shoes, punch holders, leader pins, bolster plates, bushings, and other standard die parts made by the E. A. Baumbach Manfg. Co., 1806 S. Kilbourn Ave., Chicago, Ill., are described in Catalog No. 5, which has been issued by that company. Sent free upon request.

Portable Flexible-Shaft Machines: Flexible-shaft machines of the latest design and built for heavy duty service are described in Circular No. 50, issued by The Binghamton Flexible Shaft Co., Maple Avenue, Johnson City, N. Y. Copy free upon request.

Sheet Metal Problems: The use of the nibbling machine for cutting sheet metal stock is discussed in a booklet which can be had without charge by addressing Andrew C. Campbell, Inc., Bridgeport, Conn.

Mounted Grinding Wheels for use in small holes such as are found in bushings, dies, gears, tools, etc., are described in a catalog that has been issued by the Chicago Wheel & Manfg. Co., 110 S. Aberdeen St., Chicago, Ill. Copy free upon request.

Handbook For Drillers: The Cleveland Twist Drill Co., 1242 E. Forty-ninth St., Cleveland, Ohio, has published a book in which the various parts of the twist drill are described, and which tells how to grind a drill correctly. The troubles that result from incorrect grinding are described and illustrated and several chapters are devoted to the subjects of speeds, feeds, materials, cutting compounds, and so on. Sent free upon request.

Motorize Your Cone Pulley Lathes: An attachment that can be applied to your lathe with four bolts makes it possible to motorize and modernize your lathes. Write for information to Cullman Wheel Co., 1336 Altgeld St., Chicago, Ill.

Gears Of All Kinds are described and illustrated, with specifications, in Catalog 80, which has been issued by the Chicago Gear Works, 105-9 S. Jefferson St., Chicago, Ill.

Grinding Wheel Dressers: All of the different types of grinding wheel dressers made by the Desmond-Stephan Mfg. Co., Urbana, Ohio, including Desmond-Huntington, Desmond-Sherman, Zig-Zag, Diamo-Carbo, and diamond dressers, are described and illustrated in a catalog that has been published by the firm mentioned. Free upon request.

Precision Grinding: A booklet which describes and illustrates the most modern methods of performing all kinds of precision grinding operations, showing how the Dumore grinder can be applied to various kinds of machine tools, has been published by The Dumore Company, Racine, Wis. Copy free upon request.

Interchangeable High Production Tools: Catalog No. 23, issued free by the Eclipse Counterbore Co., 7410 St. Aubin St., Detroit, Mich., describes and illustrates the interchangeable counterbores, spot facers, end form cutters, and other end cutting tools made by this firm.

"Speed" Spot Welders for welding metals from 0.0005 in. to 5/8 in. thick are described in a catalog that can be had by addressing Eisler Electric Corp., 761 South 13th Street, Newark, N. J.

Lathe Turrets of eight different types and twelve sizes are described and illustrated in Circular No. 18, issued by Fay & Scott, Dexter, Maine. Copies free upon request.

Precision Measuring Instruments: The latest types and models of dial indicators, thread lead test gages, pitch gages, thickness gages, dial comparators, and other precision measuring instruments marketed by the Federal Products Corporation, Providence, R. I., are described and illustrated in a book that will be sent free upon application to this firm.

The Involute Gear Simply Explained: A direct, clear explanation of the theory and principles of involute gearing without the use of higher mathematics can be obtained without charge by addressing The Fellows Gear Shaper Co., 78 River St., Springfield, Vt.

Formica Silent Composition Gears: A booklet telling about the uses and advantages of Formica Silent Shock Absorbing Gears, and containing a considerable amount of valuable data with rules and tables for laying out,

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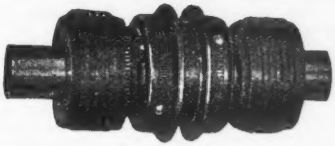

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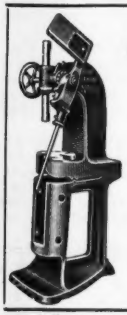

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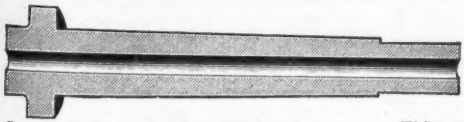

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The Bearing Metal You Have Been Looking For: Information as to the results that have been achieved by others who have used "Sabeco" bearing metal—the bearing metal with the long life—can be obtained by writing the Fredericksen Company, 841 South Water Street, Saginaw, Michigan.

Tungsten-Carbide Tipped Tools: The boring tools, counterbores, form cutters, facing heads, reamers, spotfacers, and other tools made by The Gairing Tool Co., 1629 West Lafayette Blvd., Detroit, Mich., made with or without tungsten-carbide tips, are described and illustrated in Catalog No. 20. Copy free upon request.

Adjustable Blade Cutters: Hollow mills, facing tools, face mills, milling cutters and other production tools with adjustable, interchangeable blades are described and illustrated in a booklet that is issued free by the Genesee Manufacturing Co., 141 N. Water St., Rochester, N. Y.

Ball and Roller Bearings, either journal or thrust, for all purposes and in all sizes, are described and illustrated in catalog No. 9 which has been issued by The Gwilliam Company, 360 Furman Street, Brooklyn, N. Y. Copy free upon request.

Drawing Tables: The Hamilton steel-base, adjustable drawing table is described in Catalog No. 7-MS, issued by the Hamilton Mfg. Co., Two Rivers, Wis. Copy free upon request.

Precision Bench Lathe Work can only be done on finely-built, accurate machines. The complete line of Hjorth Precision Bench Lathes is described and illustrated in a catalog that has been issued by Hjorth Lathe & Tool Company, 24 School Street, Boston, Mass. Copy free upon request.

Useful Tool Information: The Illinois Tool Works, 2503 N. Keeler Ave., Chicago, has published a catalog which describes and illustrates the standard and special cutters, mills, hobs, gear cutters, thread cutters, saws, reamers, and other tools made by this firm. The book also contains a number of useful tables and formulas. Copy free upon request.

Oil and Waterproof Chucks: The J & H Electric Co., 202 Richmond Street, Providence, R. I., is now making a chuck that is oil and waterproof, and is designed to provide a maximum of holding surface with exceptionally strong and uniform pull throughout. Ask for complete information.

Threading Machinery: Catalog No. 32, containing full descriptions of Landis threading machines, stay bolt threading machines, bolt factory threading machines, automatic forming and threading machines and chaser grinders can be had without charge by addressing Landis Machine Co., Inc., Waynesboro, Penna.

Flexibility in Cylindrical Grinding means increased production, need for less equipment, and lower costs. Send for information as to the advantages of Landis Hydraulic Grinders. Address Landis Tool Co., Waynesboro, Penna.

Air-Operated Work-Holding Devices: A booklet showing how air-operated chucks and devices of various kinds can be applied to different kinds of machines to save time and labor has been issued by The Logansport Machine Co., Logansport, Ind.

Rapid-Reading Micrometer: A new type of rapid-reading micrometer, designed to show the reading in numerals, is described in Catalog No. 5, issued by The Lufkin Rule Co., Saginaw, Michigan. The catalog also contains descriptions of the micrometers, calipers, gauges, scales, squares, bevel protractors, and other tools made by this company. Free upon request.

M-C Pinion Rod, made by the Meisselbach-Catucci Mfg. Co., 70 Stanton St., Newark, N. J., insures economy and accuracy in cut pinions. Send for information.

Installation and Maintenance of Lathes: A newly compiled booklet showing proper methods of installing, leveling and maintaining Monarch Lathes. It is useful information for every lathe user. Mailed free. Address The Monarch Machine Tool Company, Sidney, Ohio.

Compound Spot-Facing Tool: A spot-facing tool retracting, serrated roughing cutters and fixed finishing cutters in the same tool will break up the scale easily and do accurate work. Write for bulletin to Mummert-Dixon Co., 120 Philadelphia St., Hanover, Penna.

"The Answer to Your Gear Problems": Information as to correct methods of cutting and finishing gears will be supplied without charge by The National Tool Co., Cleveland, Ohio. This firm also carries a complete stock of gear shaper cutters and markets the National-Cleveland Spur and Helical Gear Grinding Machine.

Noiseless Gears: Full details concerning a service for the accurate cutting and finishing of gears, practically eliminating noise, can be had by addressing National Broach & Machine Co., Shoemaker and St. Jean, Detroit, Michigan.

Ball and Roller Bearing Data Sheets: A complete set of data sheets showing all the dimensions and loads at given speeds, and giving instructions for mounting precision ball bearing and Hoffmann roller bearings, can be obtained without charge by addressing the Norma-Hoffmann Bearings Corporation, Stamford, Conn.

"Commercial Lapping for Close Limits and High Production" is the title of a booklet that discusses hand and machine lapping, types of lapping tools and machines, workholders for machines, preparation of laps, preparation of work for lapping and other important points. A copy may be had by addressing Norton Company, Worcester, Mass.

"Fastenings" is the title of a booklet, issued by the Parker-Kalon Corporation, 192-196 Varick Street, New York, N. Y., in which are included the results of surveys made in fourteen different plants as to the efficiency of fastening methods. Copy free upon request.

Q-C Standardized Fixture Units in 677 sizes and 5 styles are described and illustrated in the Engineering Book put out by A. H. Pearson, 7 E. Grand Ave., Detroit, Mich. Copy free upon request.

Runde Offset Boring Heads: Eccentric Boring Heads, precision-made, with a minimum of overhang and a maximum boring range, to fit all standard spindles, are described and illustrated in a circular that can be had by addressing Progessive Tool Co., 419 Hendrie Street, Detroit, Michigan.

Bench Lathe Mounting and Driving Equipment: Bulletin 120-A, issued by Rivett Lathe and Grinder Corporation, Brighton, Mass., contains complete descriptions and illustrations of modern and conventional countershaft, individual motor drive jackshaft, and speed box motor drive, also benches, cabinets, oil pans, etc. Copy free upon request.

Fulmore Industrial Clutch: A multiple disc clutch, made in two types, to run in oil or dry, and which is so built that it can be operated at high speeds, is illustrated and described in a folder that will be sent free by the Rockford Drilling Machine Company, Rockford, Ill.

Automatic Lubrication: Individually motor-driven pumps that keep the work flooded with lubricant are described in a booklet that has been published by the Ruthman Machinery Co., Front and Pike Sts., Cincinnati, Ohio.

Stamp Your Name on Your Product: Full information as to the steel roller dies made by The Schwerdtle Stamp Co., 10 Cannon Street, Bridgeport, Conn., can be obtained by writing this firm.

Push-Broaching With Modern Equipment: Modern methods of finishing holes by push-broaching are described in a booklet that is issued free by the Sheldon Machine Co., 3255 Cottage Grove Ave., Chicago, Ill.

Simonds Files: A useful book on files showing the various styles made, their uses, cross-section, and cuts, and containing a number of reference tables and other information useful in a machine shop can be had by addressing Advertising Dept., Simonds Saw & Steel Co., 470 Main Street, Fitchburg, Mass.

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THE LAST WORD IN ECCENTRIC BORING HEADS

Made of Chrome Vanadium

Built rugged, compact and with precision. The largest head weighs only 8½ lbs., and has a boring range of 12 inches.

Made to fit all standard spindles. Circulars covering all sizes furnished on request.

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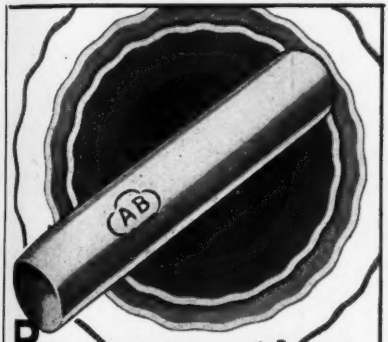

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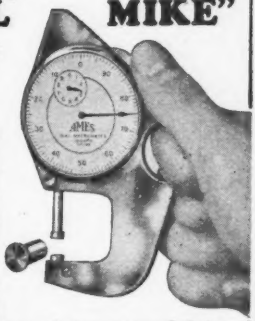

A modern dial-reading micrometer that replaces the old style "mikes"—speedier to use—easier to read—extremely accurate.

Simply move the thumb to open the anvils. Closes automatically onto part being measured. Spindle lock makes it an adjustable snap gauge if desired.

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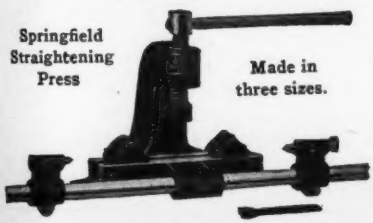

Made in three sizes.

THE Springfield Straightening Press is the ideal tool for straightening any length of rough or finished work—truing sprung tools—testing and balancing cams, or crank shafts—and scores of other jobs.

Place it on the bench—it saves your operators' time by eliminating waste steps, and allowing quicker handling of work.

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We also manufacture Engine Lathes and Shapers.

The Most Efficient Speed for the operation of special production units, power conveyors, and other machinery by the use of the WHS Speed Reducer and how it can be obtained is told in a bulletin that will be mailed free by Winfield H. Smith, Inc., 30 Eaton St., Springville, N. Y.

Speed and Accuracy In Straightening: The Springfield Straightening Press is an ideal tool for use in straightening any length or size of rough or finished work. Send for illustrated folder. Address The Springfield Machine Tool Co., 630 West Southern Avenue, Springfield, Ohio.

Cutting and Grinding Facts: A discussion of cutting oils and lubricants, together with descriptions and illustrations of various kinds of jobs upon which cutting oils are used, is contained in a booklet that is issued by the Sun Oil Company, 1608 Walnut Street, Philadelphia, Penna. Free upon request.

Rigidmiling Principles and Practice: A book that shows how the Rigidmil can be adapted to various kinds of usual and unusual milling operations, and which describes in detail the work that can be handled by this machine has been issued by the Sundstrand Machine Tool Co., Rockford, Ill. Copy free upon request.

Snap, Plug, Ring, and Thread Gages: The complete line of precision gages made by The Taft-Peirce Manufacturing Co., 32 Mechanic Ave., Woonsocket, R. I., is described in a folder which can be obtained, free, by addressing this company.

Penetrating Oil for High-Speed Equipment: Three-In-One Oil, blended scientifically from animal, mineral and vegetable oils, will penetrate the tightest bearings and lubricate high speed units perfectly. Full information can be had by writing Three-In-One Oil Co., Dept. 96, 130 William St., New York, N. Y.

Chuck With Air: How time and labor can be saved by the use of air-operated chucks, cylinders, and other equipment is told in a book which describes "Hopking" Air-Operated Equipment. Published by The Tomkins-Johnson Company, 620 N. Mechanic St., Jackson, Mich. Sent free upon request.

Change drilling speeds instantly without stopping the machine or touching a belt. This can be done with the Victor Super-Drill, made by U. S. Automatic Box Machinery Co., Newtonville, Boston, Mass. Bulletin free upon request.

Electrically-Driven Portable Tools: The "U. S." line of electric drills, die grinders, electric screw drivers, surface grinders, tool post grinders, and bench and floor grinders is described in Catalog No. 29, which has been published by The United States Electrical Tool Co., 2471 W. Sixth St., Cincinnati, Ohio.

"Extra Value" Hack Saw Blades: Hack saw blades made of an alloy in which molybdenum is used, and which are said to withstand shock and wear to an unusual degree are now being made by Victor Saw Works, Middletown, N. Y. Full particulars will be sent upon request.

Better and Faster Finishing: Finishing and polishing operations can be performed easier, better, and faster with the Simplex-M Abrasive Band Grinder, marketed by Walls Sales Corp., 96 Warren Street, New York, N. Y. Write for illustrated circular.

Wappat "Red Streak" H. D. Electric Drills that cannot be stalled by any hand drilling test are fully described and illustrated in a catalog that can be had by addressing Wappat, Incorporated, 7522 Meade Street, Pittsburgh, Penna.

Power Drive In Any Position: The modern flexible shaft makes it possible to drive all kinds and types of tools in places and positions impossible of access with straight-shaft machines. Ask The S. S. White Dental Mfg. Co., Industrial Division, 150A West 42nd Street, New York, N. Y., for the "Flexible Shaft Handbook." Copy free to any mechanical executive addressing this firm on his firm letterhead.

Mummert-Dixon Facing Heads

8 Sizes—6" to 40"

We can't say much here...but if you write for a bulletin we'll show you how this tool will save you money.

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THE WORLD'S HANDIEST 6-FT. MEASURE

SUPERIOR quality, nickel-plated blade carries accurate, legible markings. It may be projected unsupported into small openings or for any straight measuring, but will conform to curves, angles and irregular shapes. The automatic wind chromium-plated case, only 2" in diameter, completely encloses the blade, excluding dirt and dust.

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FOUR-station radio in every room of this most popular hotel, already famed among experienced travelers for its homelike comfort, good food and excellent service.

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CUTTING TOOL COSTS . . . . . .

ONE of the most costly items . . . when using ordinary tools on multiple spindle machines . . . is providing tools of exactly the same length! But, you can save this cost! You can equip your machines with ECLIPSE Adjustable Length Holders and use cutting tools of varying lengths.

That's what has been done in the ECLIPSE Set-Up shown here in action, in a well-known automobile plant. This set-up consists of twelve special adjustable length holders with standard spot facing cutters and pilots for facing bolt holes in a rear axle gear mount.

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ECLIPSE COUNTERBORE CO.
DETROIT MICH.

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By GEO. ALEXANDER MANN

They say the bottom has been reached—be they referrin' to our pockets, they're right.

Gentlemen prefer blondes 'cause they're afraid o' the dark.

An Xmas Craving

"A stocking wouldn't hold
What I want," said Miss Good,
"But I'll tell you a secret,
A pair o' socks would."

Few would put up a bluff if they had to put up their fists with it.

You may as well lose interest in a jane if you've lost your capital.

You Know the Type

She is rather meek,
And she knows her place,
She is a printer's daughter,
She has a bold face.

A college grad can be up on the dead languages and still murder the live ones.

Same Ol' Stuff

They were speedin' at 65,
The gas bus gave a lurch,
Services Sunday at 2 p. m.
At the 9th Street Baptist Church.

'Tis tuff when daughter has her father's eyes an' has to go through life pop-eyed.

There may be such things as the blessings of poverty. But you have to have a helluva lotta money to appreciate it.

Quite An Idear

Oh how blued up is Mary,
She's sure the sap of saps,
Her old typewriter ribbons
She wears for shoulder straps.

Your gas buggy may have a forty-horse motor and still be a one-horse car.

Hot Is Right

Is she a hot mamma?
Well I should shout;
Put her in a snow drift,
She'd havta swim out.

An' to think in 1929 merchants went all the way to Mammoth Cave to go in the hole.

You don't have to be up on mechanics to understand what they mean when they say that a large percentage o' the cars are worm-driven.

Some Come-Back

"What's wrong with these eggs?"
He asked his wife Mabel—
She said, "Don't ask me,
All I laid was the table."

Men are like fish—wimmin are everlastingly tellin' about the good one that got away.